STATE OF LOUISIANA
COASTAL PROTECTION AND
RESTORATION AUTHORITY
COASTAL ENGINEERING DIVISION

RIVER REINTRODUCTION
INTO MAUREPAS SWAMP

PROJECT No. PO-29
ST. JOHN THE BAPTIST PARISH, LOUISIANA

95% Specifications Submittal

September 2013
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<td>Grouted Riprap</td>
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<td>Demolition of Existing CN Railroad Tracks</td>
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<td>Sewerage Aeration Treatment System</td>
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<td>Boat Launch and Dock</td>
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GENERAL PROVISIONS

GP-1 DEFINITION OF TERMS

Whenever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to the singular or plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs and the titles of other documents or forms.

Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

1.1 **Acceptance:** A written approval from the Engineer which certifies that specific items of work in the Contract have been completed and/or obligations have been fulfilled by the Contractor.

1.2 **Addenda:** Those written or graphic documents which are issued prior to opening of Bids in accordance with the Bidding Requirements and clarify or change the bidding requirements or the proposed Contract Documents.

1.3 **Agreement:** The written and signed agreement between the Owner and Contractor specifying the Work to be performed and includes the Contract Documents, all addenda pertaining to the Bid, Notice of Award, Bonds, Plans, General Provisions, Special Provisions, and Technical Specifications.

1.4 **Application of Payment:** That form which is used by the Contractor to request partial and final payment and is deemed acceptable to the Owner. It shall be accompanied by any supporting documentation required by the Contract Documents.

1.5 **A.S.T.M.** American Society for Testing and Materials.

1.6 **Bid:** An offer or proposal submitted on the prescribed form setting forth the prices for the Work.

1.7 **Bidder:** The person, association of persons, firm, or corporation submitting a proposal for the Work.

1.8 **Bidding Requirements:** The Advertisement or Invitation to Bid, Instruction to Bidders, Form of Bid Security, if any, and Bid Form with any supplements.

1.9 **Change Order:** A written order which is submitted to the Contractor, signed by the Owner, and authorizes an addition, deletion, or revision in the Work, or an adjustment in the contract price or the contract time issued after the effective date of the Agreement.
1.10 **Claim**: A written demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both or other relief with respect to the terms of the Contract.

1.11 **Contract**: The written Agreement between the Owner and the Contractor which defines the work to be completed and shall be understood to include the Plans, Specifications, Information for Bidders, Agreement, Advertisement For Bidders, Affidavit, Bid Form, Bid Bond, Contract Bond, Notice of Award, Notice to Proceed, and Change Orders, and Claims.

1.12 **Contract Bond**: The approved form of security furnished by the Contractor and Surety for the faithful performance of the Work, and the payment for all labor, materials, and/or obligations incurred by the Contractor in the prosecution thereof.

1.13 **Contract Documents**: The Agreement, all addenda which pertains to the Contract Documents, Bid Documents and specified Attachments accompanying the Bid and any post-bid documentation submitted prior to the Notice of Award, Contractor’s Bid when attached as an exhibit to the Agreement, the Bonds (Bid and Performance/Payment), General Provisions, Special Provisions, Technical Specifications, Plans, and all Field or Change Orders issued after the execution of the Agreement. Shop Drawings and other submittals by the Contractor are not Contract Documents.

1.14 **Contract Price**: The moneys payable by the Owner to the Contractor for the Work in accordance with the Contract Documents as stated in the Agreement.

1.15 **Contract Time**: The number of calendar days specified in the Agreement for completion of the Work, together with any extensions authorized through change orders.

1.16 **Contractor**: The person, association of persons, firm, or corporation entering into the duly awarded Contract.

1.17 **Contracting Agency**: The Coastal Protection and Restoration Authority (CPRA) acting through the Louisiana Division of Administration.

1.18 **Day**: When any period of time is referred to in the Contract Documents using days, it will be computed to exclude the first day and include the last day of such period. If the last day of any such period falls on a Saturday, Sunday, or a legal holiday, that day will be omitted from the computation. A calendar day is measured as twenty-four (24) hour period starting at midnight and ending the following midnight.

1.19 **Design Report**: A written report by the Engineer which provides the design methodology for the Work.

1.20 **Effective Date of the Agreement**: The date indicated in the Agreement on which it becomes effective.
1.21 **Engineer:** The Louisiana State Coastal Protection and Restoration Authority, or its designee.

1.22 **Equipment:** All machinery, implements, and power-tools, in conjunction with the necessary supplies for the operation, upkeep, maintenance, and all other tools and apparatuses necessary for the proper construction and acceptable completion of the Work.

1.23 **Extension of Contract:** Any extension of time for completion of Work beyond the Contract Time which is granted by the Owner, recommended by the Engineer and approved by the Office of State Purchasing in the form of a Change Order.

1.24 **Federal Sponsor:** The federal agency which has been tasked to manage the implementation of the project.

1.25 **Field Order:** A written order issued by the Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or Contract Time.

1.26 **Resident Project Representative:** An authorized representative of the Engineer who is responsible to inspect the Work and materials furnished by the Contractor.

1.27 **Laboratory:** The firm, company, or corporation which is used to test materials and is approved for use by the Engineer.

1.28 **Laws and Regulations; Laws or Regulations:** Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

1.29 **Materials:** Any substance used in the Work to build structures, but does not include material used in false work or other temporary structures not incorporated in the Work.

1.30 **Milestone:** A principal event specified in the Contract Documents relating to an intermediated completion date or time prior to the Contract Times.

1.31 **Notice of Award:** A written notice to the successful Bidder stating that the Bid has been accepted by the Owner and that the successful Bidder is required to execute the Contract and furnish the Contract Performance Bond.

1.32 **Notice to Proceed:** The written notice to the Contractor by the Owner which provides the starting date for the Contract Time.

1.33 **Owner:** The Owner is the State of Louisiana (State) which acts through the Contracting Agency.

1.34 **Plans:** That part of the Contract Documents prepared or approved by the Engineer which graphically shows the scope, intent, and character of the Work to be completed by the Contractor.
1.35 **Project Site**: The location where the Work is to be performed as stated in the Agreement.

1.36 **Right-of-way**: That entire area reserved for constructing, maintaining, and protecting the proposed improvement, structures, and appurtenances of the Work.

1.37 **Samples**: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portions of the Work will be judged.

1.38 **Shop Drawings**: All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for the Contractor and submitted by the Contractor to illustrate some portion of the Work to be performed.

1.39 **Specifications**: That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the work to be performed and certain administrative details applicable thereto.

1.40 **State**: The State of Louisiana.

1.41 **Structures**: Bridges, plugs, weirs, bulkheads, berms, dams, levees, and other miscellaneous construction encountered during the Work and not otherwise classified herein.

1.42 **Subcontractor**: Any person, association of persons, firm, or corporation who contracts with the Contractor to perform any part of the project covered by the Contract.

1.43 **Submittals**: Certificates, samples, shop drawings, and all other project data which are submitted to the Engineer in order to verify that the correct products will be installed on the project.

1.44 **Successful Bidder**: The lowest responsible Bidder whom the Owner makes an award.

1.45 **Special Provisions**: That part of the Contract Documents which amends or supplements these General Provisions.

1.46 **Surety**: The corporate body, licensed to do business in Louisiana, bound with and for the Contractor’s primary liability, and engages to be responsible for payment of all obligations pertaining to acceptable performance of the Work contracted.

1.47 **Temporary Structures**: Any non-permanent structure required while engaged in the prosecution of the Contract.

1.48 **Work**: All work specified herein or indicated on the Plans.
1.49 Work Plan: A written plan by the Contractor that details how the Work will be provided including layout drawings, projected schedule (Initial Progress Schedule), and a list of labor hours, materials, and equipment.

GP-2 BID REQUIREMENTS

The Contract and Bonds which govern the Work shall be performed in accordance with the Plans, Specifications, and the Louisiana Standard Specifications for Roads and Bridges, 2006 edition. The Bidder understands that all quantities for performing the Work have been estimated by the Engineer, and that the Bid shall be the sum of the quantities multiplied by their respective unit rates. The Contract shall be awarded by the Owner through a comparison of all bids. It is the responsibility of each Bidder before submitting a Bid to:

2.1. Examine the Bidding Documents including the Plans and Specifications and any Addenda or related data identified in the Bidding Documents;

2.2. Visit the Project Site to become familiar with the local conditions if they are believed to affect cost, progress, or the completion of the Work;

2.3. Become familiar and satisfied with all federal, state, and local Laws and Regulations that may affect cost, progress, or the completion of the Work;

2.4. Study and correlate all information known to the Bidder including observations obtained from Bidder’s visits, if any, to the Project Site, with the Bidding Documents;

2.5. Submit a written notice to the Engineer within three (3) days regarding any conflicts, errors, ambiguities, or discrepancies discovered in the Bidding Documents and confirm that the written resolution thereof by the Engineer is acceptable to the Bidder; and

2.6. Determine that the Bidding Documents are generally sufficient to convey an understanding of all terms and conditions for completing the required Work.

The submission of a Bid will constitute an incontrovertible representation that the Bidder has complied with every requirement of these Specifications. The Bidder shall comply with all other requirements specified in the Notice to Bidders.

GP-3 AVAILABILITY OF PLANS AND SPECIFICATIONS

One (1) set of Plans and Specifications shall be furnished to each Bidder. Three (3) sets of the Plans and Specifications shall be furnished to the Contractor upon award of the Contract. Additional sets may be furnished to the Contractor upon request from the Engineering Division of the Coastal Protection and Restoration Authority, 450 Laurel Street, 11th Floor, Baton Rouge, Louisiana 70801.

GP-4 LAWS, REGULATIONS, STANDARDS, SPECIFICATIONS, AND CODES

Bidders are required to become familiar and remain in compliance with all Federal, State, and local laws, ordinances, and regulations which may affect all employees and
execution of the Work. The filing of a bid will be presumptive evidence that the Bidder has complied with this requirement. The Owner will not be responsible for any inaccurate interpretations or conclusions drawn by the Contractor from information and documentation provided by the Owner.

References to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws and Regulations, whether such reference be specific or by implication, may not be in effect at the time of opening the Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents. No provision of any such standard, specification, manual, or code, or any instruction of a supplier shall be effective to change the duties or responsibilities of the Owner or Engineer, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Bid Documents. No such provision shall be effective to assign to the Owner or Engineer, or any of their consultants, agents, or employees any duty or authority to supervise or direct the performance of the Contractor’s obligations or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

The Contractor shall indemnify the Owner and its representatives against any claim or liability arising from all violations of any laws, bylaws, ordinances, codes, regulations, orders, or decrees. The obligations imposed by these specifications are in addition to and are not to be construed in any way as a limitation of any rights available to the Engineer or Owner which are otherwise imposed by any laws or regulations or other provisions within the Contract Documents.

The Contractor shall abide by laws set forth in the Davis-Bacon Act of 1931 which states that all laborers and mechanics employed by recipients, the recipient’s contractors, or subcontractors on this project shall be paid wages at rates no less than those prevailing on projects of a character similar in the locality as determined by the Secretary of Labor in accordance with Subchapter IV of Chapter 31 of Title 40 United States Code. Additionally, with respect to the labor standards specified in this section, the Secretary of Labor shall have the authority and functions set forth in Reorganization Plan Number 14 of 1950 (64 Stat. 1267; 5 U.S.C. App.) and The Copeland Act of Title 40 (40 U.S.C. § 3145). Prevailing Wage Determination Schedules, as determined by the United States Department of Labor, are provided in the Appendix. Prevailing Wage Determination Schedules are subject to modification by the United States Department of Labor. The Contractor is responsible for utilizing the most current Prevailing Wage Determination Schedule. These documents can be downloaded from the following link: http://www.wdol.gov/dba.aspx#3. Modifications to Prevailing Wage Determination Schedules shall be effective if received (or posted) no less than 10 days prior to bid opening.

GP-5  PRE-BID CONFERENCE AND SITE VISIT

A Pre-Bid conference will be held at the location and on the date provided in the Bid Solicitation. A site visit may also be held at the Project Site as specified in the Bid Solicitation or at the Pre-Bid conference. Bidders will be required to furnish their own transportation to the Project Site. Representatives of the Owner and Engineer will attend the Pre-Bid conference and site visit, if held, to discuss the Work.
Bidders are required to attend the Pre-Bid conference and site visit, if held. Failure to attend will result in a null or void Bid.

All questions shall be in writing and faxed to the Office of State Purchasing (OSP) after the Pre-Bid conference and by the due date announced at the Pre-Bid conference. No additional questions shall be received after the specified pre-bid conference submittal deadline. Oral statements will not be binding or legally effective. The Office of State Purchasing will submit addenda in response to all questions arising at the Pre-Bid Conference and site visit to all prospective Bidders on record. All prospective Bidders on record may contact the Office of State Purchasing for any additional information.

GP-6 NOTICE OF AWARD

The Owner shall provide written notice to the Successful Bidder stating that the Owner will sign and deliver the Agreement upon compliance with the conditions enumerated therein and within the time specified.

GP-7 NOTICE TO PROCEED AND CONTRACT TIME

The Contractor shall start the Work and begin the Contract Time on the dates provided in the Notice to Proceed. The Work shall be conducted using sufficient labor, materials, and equipment as necessary to ensure completion within the Contract Time. The Contract Time for completion of the Base Bid for the Work is provided in Special Provisions, unless an extension is granted to the Contract Time as specified in paragraph “EXTENSION OF CONTRACT TIME”.

GP-8 WORK PLAN

The Contractor shall develop a written Work Plan which accounts for all of the construction activities required by the Contract Documents. The Work Plan shall include a list of the individual construction tasks to be completed and the estimated dates for beginning and completing the tasks. It shall also include all other items which are applicable to completing the Work such as, but not limited to, the following:

8.1 Typical report form for the Bi-Weekly Progress Meeting;
8.2 Typical form for Daily Progress Report;
8.3 Hurricane and Severe Storm Plan;
8.4 Site-specific Health and Safety Plan;
8.5 The delivery method and source(s) of all construction materials (company or producer name, mailing and physical address, phone number, and name of contact person).
8.6 The personnel, material, subcontractors, fabricators, suppliers, types of equipment, and equipment staging areas the Contractor proposes to use for construction;
8.7 Shop drawings, test results, and sample submittals;

8.8 Survey layout and stakeout;

8.9 All supplemental items specified in Special Provisions.

The Work Plan shall be submitted to the Engineer prior to the Pre-Construction Conference by the date provided in Special Provisions. The Engineer shall review the Work Plan and have the Contractor make any necessary revisions prior to acceptance of the plan. **No payment for mobilization will be made until the Work Plan has been accepted by the Engineer.**

**GP-9 PROGRESS SCHEDULE**

The Contractor shall develop a written Progress Schedule which provides for an orderly progression of the Work, submittals, tests, and deliveries in order to complete the Work within the specified Milestones and Contract Time. All of the items listed in the Work Plan shall be integrated into the Progress Schedule. The format of the schedule shall be composed using Microsoft Project®, or any other software deemed acceptable by the Engineer. It shall be updated weekly by the Contractor, at a minimum. The Progress Schedule shall also include, but not be limited to the following:

9.1 All of the elements in the Work Plan, including updates;

9.2 A work order issued from Louisiana One Call ordering all their subscribers in the project area to mark their utilities;

9.3 A telephone log verifying that all property owners and utilities have been contacted. This log should list the time, date, and names of the personnel representing the property owners, utilities, and Contractor;

The following table defines the monthly anticipated adverse weather days that are expected to occur during the Contract Time and will constitute the baseline monthly weather time for evaluations. The schedule is based upon National Oceanic and Atmospheric Administration (NOAA) or similar data for the regional geographic area.

| Monthly Anticipated Adverse Weather Calendar Days |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 5    | 5    | 4    | 4    | 5    | 7    | 7    | 5    | 3    | 3    | 4    |

The Progress schedule must reflect these anticipated adverse weather delays on all weather dependent activities. Adverse weather days must prevent Work for fifty percent (50%) or more of the work day and delay work critical to the timely completion of the project. The number of actual adverse weather days shall be calculated chronologically from the first to the last day of each month.
The Progress Schedule shall be submitted to the Engineer prior to the Pre-
Construction Conference by the date provided in Special Provisions. The Engineer
shall perform a review and have the Contractor make any necessary revisions prior to
acceptance of the schedule. Acceptance will not impose responsibility on the Owner
or Engineer for the sequencing, scheduling, or progression of the Work. The
Contractor is fully responsible for progression of the Work in order to maintain the
compliance with the Progress Schedule.

GP-10 DAILY PROGRESS REPORTS

The Contractor shall record the following daily information on Daily Progress
Reports:

10.1 Date and signature of the author of the report;

10.2 Dollar amount of all bid items that are fabricated, installed, backfilled, pumped,
constructed, damaged, replaced, etc. The amount of material shall be
expressed in the units stated in the bid;

10.3 Field notes of all surveys;

10.4 Notes on all inspections;

10.5 Details of Health and Safety meetings;

10.6 A brief description of any Change Orders, Field Orders, Claims, Clarifications,
or Amendments;

10.7 Condition of all navigation aides (I.E., warning signs, lighted marker buoys)
and any repairs performed on them;

10.8 Weather conditions (adverse weather day, wind speed and direction,
temperature, wave height, precipitation, etc.);

10.9 The amount of time lost to severe weather or personnel injury, etc.;

10.10 Notes regarding compliance with the Progress Schedule;

10.11 Visitor log (Instructions for format will be furnished by the Field Engineer).

The daily progress reports shall be submitted to the Engineer at the Bi-Weekly
Progress Meetings specified in paragraph “PROGRESS MEETINGS AND
REPORTS” in both hard copy and digital format (Adobe Acrobat® Format, or
approved equal). The typical form for Daily Progress Reports shall be developed by
the Contractor and incorporated into the Work Plan.

GP-11 HURRICANE AND SEVERE STORM PLAN

The Contractor shall develop and maintain a written Hurricane and Severe Storm
Plan. The Plan shall include, but not be limited to, the following:
11.1 What type of actions will be taken before storm strikes at the Project Site. The plan should specify what weather conditions or wave heights will require shutdown of the Work and removal of equipment, personnel, etc.

11.2 Notes from continuous monitoring of NOAA marine weather broadcasts and other local commercial weather forecasts.

11.3 Equipment list with details on their ability to handle adverse weather and wave conditions.

11.4 List of safe harbors or ports and the distance and travel time required to transfer equipment from the Project Site.

11.5 Hard copies of any written approvals or operations schedules associated with the use of the safe harbors or ports.

11.6 Method of securing equipment at the safe harbors or ports.

11.7 List of tug boats and work boats and their respective length, horsepower, etc. which will adequately transfer the equipment to safe harbor or port under adverse weather conditions.

11.8 Methods which will be used to secure equipment left onsite during adverse weather conditions.

11.9 Evacuation or immediate reaction plans to be taken by personnel for sudden storm occurrences.

11.10 Operations procedures which will be used to secure critical dredging equipment such as spuds, swing wires, anchor wires, or tugs during adverse weather conditions.

11.11 Communications protocol with local law enforcement and fire and rescue agencies.

The Contractor shall incorporate the Hurricane and Severe Storm Plan into the Work Plan. The Owner and Engineer are not responsible for the adequacy of this plan.

**GP-12 HEALTH AND SAFETY PLAN AND INSPECTIONS**

The Contractor shall develop and maintain a written Health and Safety Plan which allows the Work to be performed in compliance with all applicable laws, ordinances, rules, and regulations of any government agency having jurisdiction over the safety of personnel or property. This includes maintaining compliance with the Code of Federal Regulations, Title 29, Occupational Safety and Health Administration (OSHA) and all applicable Health and Safety Provisions of the State of Louisiana.

The Contractor shall institute a daily inspection program to assure that the requirements of the Health and Safety Plan are being fulfilled. Inspections shall include the nature of deficiencies observed, corrective action taken or to be taken, location of inspection, date, and signature of the person responsible for its contents.
The results of the inspections shall be recorded on Daily Progress Reports and kept at the Project Site during the Work.

The Contractor shall incorporate the Health and Safety Plan into the Work Plan. The Owner and Engineer are not responsible for the adequacy of this plan.

GP-13 PROGRESS MEETINGS AND REPORTS

The Engineer shall schedule meetings bi-weekly to review the progress of the Work, coordinate future efforts, discuss compliance with the Progress Schedule and resolve miscellaneous problems. The Engineer or Resident Project Representative, Contractor, and all Subcontractors actively working at the Project Site shall attend each meeting. Representatives of suppliers, manufacturers, and other Subcontractors may also attend at the discretion of the Contractor. The Contractor shall record the details of each meeting in a Progress Report. The format of this report shall be developed by the Contractor, approved by the Engineer, and included in the Work Plan. The progress meetings and reports shall be scheduled according to the Special Provisions.

GP-14 PRE-CONSTRUCTION CONFERENCE

A Pre-Construction Conference shall be held by the Contractor, Owner, Engineer, local stakeholders, and other appropriate personnel prior to starting construction on the date specified in the Special Provisions. This conference shall serve to establish a mutual understanding of the Work to be performed, the elements of the Progress Schedule and Work Plan, expectations for bi-weekly progress meetings, the Plans and Specifications, processing Applications for Payment, and any other items of concern. If any subcontractors are not present, another pre-construction conference will be required.

GP-15 CONTRACT INTENT

The Bid Documents are complementary; what is called for by one is as binding as if called for by all. Clarifications and interpretations or notifications of minor variations and deviations of the Contract Documents will be issued by Engineer as provided in these Specifications. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Bid Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided at no additional cost to the Owner.

GP-16 ENGINEER AND AUTHORITY OF ENGINEER

The Engineer will be the designated representative of the Owner, the initial interpreter of the Contract Documents and the judge over acceptability of all the Work. Claims, disputes, and other matters relating to the acceptability of the Work, performance by the Contractor or the interpretation of the requirements of the Contract Documents must be submitted to the Engineer in writing. Upon written request from the Contractor, the Engineer shall issue written clarifications or interpretations which are consistent with the overall intent of the Contract Documents. Such written clarifications and interpretations will be binding on the Owner and the Contractor. Either the Owner or the Contractor may make a Claim if
a written clarification or interpretation justifies an adjustment in the Contract Price or Contract Times.

The Engineer has the authority to suspend the Work in whole or in part due to failure of the Contractor to correct conditions unsafe for workmen or the general public, carry out provisions of the Contract, perform conformance work, or to carry out orders. The Engineer shall submit a written order to the Contractor for work which must be suspended or resumed. Nothing in this provision shall be construed as establishing responsibility on the part of the Engineer for safety which is the responsibility of the Contractor.

The Engineer shall keep a daily record of weather and flood conditions and may suspend the Work as deemed necessary due to periods of unsuitable weather, conditions considered unsuitable for execution of the Work, or for any other condition or reason deemed to be in the public interest.

GP-17 CONFORMITY WITH PLANS AND SPECIFICATIONS

All work and materials involved with the Work shall conform with the lines, grades, cross sections, dimensions, and other requirements shown on the Plans or indicated in these Specifications unless otherwise approved by the Engineer.

GP-18 CLARIFICATIONS AND AMENDMENTS TO CONTRACT DOCUMENTS

The Contract Documents may be clarified or amended by the Engineer to account for additions, deletions, and revisions to the Work after the Effective Date of the Agreement. The clarifications and amendments shall be addressed by either a Change Order or a written clarification by the Engineer. The Contractor shall not proceed with the Work until the Change Order or clarification has been issued by the Engineer. The Contractor shall not be liable to the Owner or Engineer for failure to report any such discrepancy unless the Contractor had reasonable knowledge.

The Contractor may request a clarification or amendment for the following:

18.1 Any conflict, error, ambiguity, or discrepancy within the Contract Documents; or

18.2 Any conflict, error, ambiguity, or discrepancy between the Bid Documents and the provision of any Law or Regulation applicable to the performance of the Bid; or

18.3 Any standard, specification, manual, or code (whether or not specifically incorporated by reference in the Bid Documents); or

18.4 Instructions by a supplier.

The official form for a written clarification shall be requested from the Engineer. This form shall be filled out appropriately by the Contractor and submitted to the Engineer. The Engineer shall clarify the issue in writing on either the clarification form or a Change Order and submit it to the Contractor.
GP-19 SUBCONTRACTS

The Contractor shall provide the names of all Subcontractors to the Engineer in writing before awarding any Subcontracts. The Contractor shall be responsible for the coordination of the trades and Subcontractors engaged in the Work. The Contractor is fully responsible to the Owner for the acts and omissions of all the Subcontractors. The Owner and Engineer will not settle any differences between the Contractor and Subcontractors or between Subcontractors. The Contractor shall have appropriate provisions in all Subcontracts to bind Subcontractors to the Contractor by the terms of the General Conditions and other Contract Documents, as applicable to the Work of Subcontractors. The provisions should provide the Contractor the same power regarding termination of Subcontracts that the Owner may exercise over the Contractor under any provisions of the Contract Documents.

GP-20 WORKERS, METHODS, AND EQUIPMENT

The Contractor shall provide competent, qualified, and trained personnel to perform the Work. The Contractor shall not employ any person found objectionable by the Engineer. Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform the Work in a proper, skillful, and orderly manner shall be immediately removed upon receiving a written order by the Engineer. The Engineer may also suspend the Work until the Contractor removes the employee or provides a suitable replacement. Such an employee shall not be re-employed in any portion of the Work without written approval from the Engineer.

The on-site superintendent for the Contractor shall be competent, English-speaking, and qualified to receive orders, supervise, and coordinate all Work for the Contractor and any Subcontractors. The qualifications of the superintendent must be established and approved by the Engineer prior to commencement of the Work. The superintendent shall be furnished by the Contractor regardless of how much Work may be sublet. In the performance of the Work under this Contract, the Contractor shall conduct operations to avoid interference with any other Contractors.

All equipment, products, and material incorporated into the Work shall be as specified, or if not specified, shall be new, of good quality, and protected, assembled, used, connected, applied, cleaned, and conditioned in accordance with the manufacturer’s instructions, except as otherwise may be provided in the Bid Documents. All equipment shall be of sufficient size and mechanical condition to meet the requirements of the Work and produce a satisfactory quality of work. Equipment shall not damage adjacent property throughout the performance of the Work. The Plant and Equipment Schedule should be completed by the Contractor.

The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures used to complete the Work in conformance with the Contract Documents.

The Contractor shall obtain permission from the Engineer if a method or type of equipment other than specified in the Contract is desired. The request shall be in writing and shall include a full description of the methods, equipment proposed, and reasons for the modification. A proposed item of material or equipment may be
considered by the Engineer to be functionally equal to an item specified in the Contract if:

20.1 It is at least equal in quality, durability, appearance, strength, and design characteristics;

20.2 There is no increase in any cost including capital, installation, or operating to the Owner;

20.3 The proposed item will conform substantially, even with deviations, to the detailed requirements of the item named in the Bid Documents.

If, after trial use of the substituted methods or equipment, the Engineer determines that the Work produced does not meet Contract requirements, the Contractor shall discontinue use of the substituted methods or equipment and shall complete the Work with the specified methods and equipment. The Contractor shall remove the deficient Work and replace it with Work of specified quality or take other corrective action as directed. No change will be made in basis of payment for construction items involved or in Contract Time as a result of authorizing a change in methods or equipment.

GP-21 ACCIDENT PREVENTION, INVESTIGATIONS, AND REPORTING

The Contractor shall be responsible to develop and maintain all safeguards and safety precautions necessary to prevent damage, injury, or loss throughout the performance of the Work. All accidents at the Project Site shall be investigated by the immediate supervisor of employee(s) involved and reported to the Engineer or Resident Project Representative within one (1) working day. A complete and accurate written report of the accident including estimated lost time days shall be submitted to the Engineer within four (4) calendar days. A follow-up report shall be submitted to the Engineer if the estimated lost time days differ from the actual lost time days.

GP-22 PRESERVATION AND RESTORATION OF PROPERTY, MONUMENTS, ETC.

The Contractor shall comply with all applicable laws, ordinances, rules, and regulations of any government agency having jurisdiction over the preservation and protection of public and private property. The Contractor shall install and maintain suitable safeguards and safety precautions during the Work as necessary to prevent damage, injury, or loss to property. This responsibility shall remain with the Contractor until the Work has been completed and accepted. Any damage, injury, or loss to property which is caused by the Contractor or Subcontractors shall be repaired or replaced at the expense of the Contractor.

The Contractor shall protect all land monuments, State and United States bench marks, geodetic and geological survey monuments, and property markers from disturbance or damage until an authorized agent has witnessed or otherwise referenced their location. The Contractor shall also provide protection for all public and private property including trees, utilities, pipes, conduits, structures, etc. These items shall not be removed unless directed by the Engineer.
The Contractor shall be responsible to completely repair all damages to public or private property due to any act, omission, neglect, or misconduct in the execution of the Work unless it is due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, public enemies, or governmental authorities. The damage must be repaired at the expense of the Contractor before final acceptance of the Work can be granted by the Engineer. If the Contractor fails to repair the damage within forty-eight (48) hours, the Owner may independently proceed with the repairs at the expense of the Contractor by deducting the cost from the Contract. If the Contractor cannot provide for the cost of repairs, the Surety of the Contractor shall be held until all damages, suits, or claims have been settled.

GP-23 PROTECTION OF THE WORK, MATERIALS, AND EQUIPMENT

It shall be the responsibility of the Contractor to protect the Work, materials, and equipment from damages or delays due to inflows, tidal rise, and storm water runoff which may occur at the Project Site. The Owner shall not be held liable or responsible for these types of delays or damages.

GP-24 LAND RIGHTS

The Owner has been granted all of the temporary easements, servitudes, and right-of-way agreements from public and private landowners in order to perform the Work. The Contractor is responsible to notify all of the contacts and abide by stipulations listed in that memorandum.

GP-25 UTILITIES

The Owner has been granted all of the temporary easements, servitudes, and right-of-way agreements from public and private utilities in order to perform the Work. The utilities include, but are not limited to telephone, power poles or lines, water or fire hydrants, water or gas mains and pipelines, sewers, conduits, and other accessories or appurtenances of a similar nature which are fixed or controlled by a city, public utility company or corporation.

The Contractor shall conduct the Work in such a manner as to cooperate and minimize inconveniences with utilities. Prior to commencement of the Work, the Contractor is responsible to notify all of the utilities and abide by stipulations required by the utility company(s). The Contractor shall also call Louisiana One Call at 1-(800)-272-3020 a minimum of 5 working days prior to construction to locate existing utilities at the Project Site.

Any damage to utilities that is caused by the Contractor within the Project Site shall be repaired at the expense of the Contractor. The Owner will not be responsible for any delay or damage incurred by the Contractor due to working around or joining the Work to utilities left in place or for making adjustments.

Any unidentified pipes or structures which may be discovered within the limits of the Project Site shall not be disturbed and shall be reported to the Engineer as soon as possible. Construction or excavation shall not be performed around unidentified
utilities without prior approval from the Engineer. The Contractor shall contact Utility Companies or LA One to identify unknown utilities.

**GP-26 PERMITS**

Federal and State permits that are required to perform the Work (I.E., Joint Coastal Use Permit from the United States Army Corps of Engineers and the Louisiana Department of Natural Resources, LDEQ Clean Water Permit, LDWF Fill Material License, U.S. Fish and Wildlife Permit, LADOTD highway crossing permit, Railroad permits, etc.) have been secured by the Owner and are provided in these Specifications. These permits will not relieve the responsibility of the Contractor from obtaining any additional permits which may be required to complete the Work. The Contractor shall submit copies of these additional permits to the Owner. The Contractor shall conform to the requirements therein and display copies of the permits in a public setting at the Project Site at all times.

**GP-27 PROJECT SITE CLEAN-UP**

The Contractor shall keep the Project Site free from accumulations of waste material or trash at all times. All trash and waste materials shall be removed by the Contractor and disposed off-site in an approved waste disposal facility. In addition, all equipment, tools, and non-conforming work shall also be removed prior to the Work being accepted. No materials shall be placed outside of the Project Site.

**GP-28 OWNER INSPECTION**

The Owner, Resident Project Representative, and Federal Sponsor shall have the right to perform reasonable inspections and testing of the Work at the Project Site. Access shall be granted to the entire Project Site including all materials intended for use in the Work. The Contractor shall allow reasonable time for these inspections and tests to be performed. The inspections shall not relieve the Contractor from any obligation in accordance with the requirements of the Contract.

The Owner shall notify the Contractor prior to all tests, inspections, and approvals of the Work which are to be conducted at the Project Site. The Owner shall also provide the Contractor with the written results of all inspections and tests. Inspections, tests, or Payments made by the Owner shall not constitute acceptance of non-conforming Work of prejudice the Owner’s rights under the Contract.

**GP-29 DUTIES OF RESIDENT PROJECT REPRESENTATIVE**

A Resident Project Representative shall be assigned by the Engineer to the Project Site to observe the Contractor and monitor the progress and manner in which the Work is being performed. The Resident Project Representative will also report to the Engineer and Contractor whenever materials or Work fail to comply with the Contract. The Resident Project Representative is authorized to reject any materials which does not comply with the Contract until the issue is resolved by the Engineer.

However, the Resident Project Representative is not authorized to revoke, alter, enlarge, relax, or release any requirements of the Contract, or to approve or accept any portion of the Work, or to issue instructions contrary to the Plans and
Specifications. The Resident Project Representative shall not manage or perform duties for the Contractor.

GP-30 CONSTRUCTION STAKES, LINES, AND GRADES

The Engineer shall direct the Contractor to all control points necessary for setting stakes and establishing lines and grades as shown on the Plans. The Contractor shall be responsible for laying out all of the Work. All layouts shall be witnessed and verified by the Engineer or Resident Project Representative prior to beginning the Work. The Contractor shall be responsible for proper execution of the Work according to the layouts after receiving verification from the Engineer.

The Contractor shall be responsible for furnishing and maintaining stakes such that the Work can be verified for acceptance. The Engineer may suspend the Work at any time if it cannot be adequately verified due to the number, quality, or condition of the stakes.

GP-31 CONTRACTOR’S RESPONSIBILITY FOR WORK

The Contractor shall execute all items covered by the Contract, and shall furnish, unless otherwise definitely provided in the Contract, all materials, implements, machinery, equipment, tools, supplies, transportation, and labor necessary to complete the Work. The Contractor shall pay constant attention to the progress of the Work and shall cooperate with the Engineer in every way possible. The Contractor shall maintain a complete copy of the Contract at all times, including the Plans, Specifications, and any authorized modifications.

GP-32 CONTROL OF SILTATION AND WATER POLLUTION

The Contractor shall comply with all applicable Federal and State regulations and statutes relating to the prevention and abatement of pollution in the performance of the Contract. The Contractor shall conduct the Work in a manner that will not cause damaging concentrations of silt or pollution to water. The Contractor shall prevent fuels, oils, bituminous materials, chemicals, sewage, or other harmful contaminants from entering the land or water.

GP-33 SANITARY PROVISION

The Contractor shall provide and maintain sanitary accommodations for use by all employees and Subcontractors. Facilities shall comply with the requirements of the Louisiana State Board of Health and Hospitals and other authorities having jurisdiction. Committing public nuisance on the Project Site is prohibited.

GP-34 PAYMENT OF TAXES

The Contractor shall be responsible for all taxes and duties that may be levied under existing State, Federal, and local laws during the completion of the Work. The Owner will presume that the amount of such taxes is included in the unit prices bid by the Contractor and will not provide additional reimbursement.
GP-35 RADIO AND TELEPHONES

The Contractor shall furnish and maintain radio and telephone equipment throughout the Contract Time which will allow communication between the Contractor and the Engineer or Resident Project Representative.

GP-36 NAVIGATION

All marine vessels shall comply with the following Federal Laws and Regulations:

36.1 The International Navigational Rules Act of 1977 (Public Law 95-75, 91 Stat. 308, or 33 U.S.C. 1601-1608); and


These rules can be found on the Internet at: http://www.navcen.uscg.gov/mwv/navrules/navrules.htm. All marine vessels shall display the lights and day shapes required by Part C- Lights and Shapes of the Inland Navigation Rules. The location, type, color, and size of the lights and day shape shall be in accordance with Annex I - Positioning and Technical Details of Lights and Shapes. Any vessel engaged in dredging is considered a “Vessel restricted in her ability to maneuver” and shall display all the lights and shapes required in Rule 27, “Vessel Not Under Control.”

GP-37 OBSTRUCTION TO NAVIGATION

The Contractor shall minimize all obstructions to navigation in compliance with pertinent U. S. Coast Guard regulations while conducting the Work. The Contractor shall promptly move any floating equipment or marine vessels which obstruct safe passage of other marine vessels. Upon completion of the Work, the Contractor shall remove all marine vessels and other floating equipment such as temporary ranges, buoys, piles, and other marks or objects that are not permanent features of the Work.

GP-38 MARINE VESSELS AND MARINE ACTIVITIES

All marine vessels operated by the Contractor shall possess a valid United State Coast Guard (USCG) inspection certificate and current American Bureau of Shipping (ABS) Classification. All officers and crew shall possess valid USCG licenses as required by USCG regulations. These certificates, classifications, and licenses shall be posted in a public area on board each vessel.

All marine vessels not subject to USCG certification or ABS Classification shall be inspected annually by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). All inspections shall be documented using an appropriate report format. At a minimum, the inspections shall evaluate the structural integrity of the vessel and comply with the National Fire Protection Association Code No. 302- Pleasure and Commercial Motor Craft. The most recent inspection report shall be posted in a public area on board each vessel.
GP-39 RECORD KEEPING

The Contractor shall maintain orderly records of the Progress Schedule, Daily Progress Reports, Progress Meetings, correspondence, submittals, reproductions of original Contract Documents, Change Orders, Field Orders, certificates, additional drawings issued subsequent to the executed Contract, clarifications and interpretations of the Contract Documents by the Engineer, and other related documents at the Project Site until all of the Work is accepted by the Engineer.

GP-40 CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in three (3) copies. Each certificate shall be certified by an authorized agent of the supplying company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date of shipment. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the testing date. The Contractor shall also certify that all materials and test reports conform to the requirements of the Contract. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material if the material is tested and determined to be in nonconformance.

GP-41 SUBMITTALS

The Contractor shall review all Submittals for compliance with the requirements of the Contract prior to delivery to the Engineer. Each Submittal shall contain a signed statement by the Contractor that it complies with the Contract requirements with any exceptions explicitly listed. The Contractor shall comply with these requirements for Submittals from Subcontractors, manufacturers, and suppliers.

All Submittals shall include sufficient data to demonstrate that the requirements of the Contract are met or exceeded. All submittals shall be legible and marked with the project title and clearly identify the item submitted. Each submittal package shall include an itemized list of the items submitted.

All Submittals shall be reviewed within fourteen (14) days after being received by the Engineer. The Contractor shall allow the Engineer sufficient time for review, corrections, and resubmission of all Submittals prior to beginning the associated Work. The Contract Time shall not be extended based on incorrect or incomplete Submittals.

GP-42 CLAIMS FOR EXTRA COST

The Contractor is expected to complete the Work according to the Contract Price specified in the Bidding Documents. If the Contractor deems additional compensation is due for work, materials, delays or other additional costs/or expenses not covered in the Contract or not ordered as extra work, the Contractor shall give the Engineer written notice thereof within fourteen (14) calendar days after the receipt of such instructions and, in any event, before commencing the procedure. The Contractor shall justify the claim for extra cost by providing supporting data and calculations. The Engineer shall determine whether the Contractor is entitled to be
compensated for such extra cost and shall make any required adjustments of the Contract in accordance with GP-43. If no written claim is made within this fourteen (14) calendar-day period, the Contractor will be deemed to have waived any claim for extra cost for such work.

Claim for damages or delays of the Work shall not be made by the Contractor for a relocation of the construction operation or portions thereof to other locations within the geographical scope of the project, when in the opinion of the Engineer, such relocation is necessary for the most effective prosecution of the Work and may be accomplished without undue hardship.

**GP-43 ALTERATION OF THE CONTRACT AND COMPENSATION**

Using Change Orders, Field Orders, or Written Amendments, the Owner may order extra work or make changes by altering the details of construction, add to or deduct from the Work. The requirements and stipulations of these documents shall be binding on the Owner and Contractor throughout the remainder of the Contract. Any claim for an extension of Contract Time caused thereby shall be adjusted at the time of ordering such change.

The value of any such extra work or change shall be determined in one or more of the following ways and in the following priority:

43.1 By application of the unit prices in the Contract to the quantities of the items involved or subsequently agreed upon; or

43.2 By mutual acceptance between the Owner and Contractor of a lump sum.

If none of the above methods is agreed upon, the Contractor, provided he is so ordered by the Owner in writing, shall proceed with the Work on a “force account” basis. In such a case, the Contractor shall keep and preserve in such form as the Engineer may direct, a correct itemized account of the direct cost of labor, materials, equipment, together with vouchers bearing written certification by the Contractor. In any case, the Engineer shall certify to the amount, including an allowance of fifteen percent (15%) for jobsite and home office overhead indirect expenses and profit due to the Contractor. Where such change involves a subcontractor, an allowance of fifteen percent (15%) for overhead and profit shall be due the subcontractor and an allowance of ten percent (10%) shall be due the Contractor. Pending final determination of value, payments on account of changes shall be made on the Engineer’s estimate and as approved in an executed Change Order.

If the Contractor is prevented from completing the Work according to the Contract Price due to the Owner, the Contractor may be entitled to any reasonable and necessary addition of cost as determined by the Engineer. Neither the Owner nor the Contractor shall be entitled to any damages arising from events or occurrences which are beyond their control, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, acts of war, and other like matters. The provisions of this section exclude recovery for damages caused by the Contractor and compensation for additional professional services by either party.
GP-44 EXTENSION OF CONTRACT TIME

The Contractor is expected to complete the Work within the Contract Time specified in the Bidding Documents. A legitimate increase of the Contract time may be requested by the Contractor throughout the course of the Work. This Claim must be submitted to the Engineer in writing within fourteen (14) days of the event which caused the time delay to the Contractor. If an extension of Contract Time involves an increase in Contract Price, both claims shall be submitted together. The Contractor shall justify the increase of the Contract Time in the Claim using supporting data and calculations. The Engineer may deny the claim if there is insufficient information to make a determination. If the Claim is approved, the Engineer shall issue a Change Order within thirty (30) days of the Claim. The Contract Time shall be increased on a basis that is commensurate with the amount of additional or remaining Work. For example, the Contract Time can be increased where the number of actual adverse weather days exceeds the number of days estimated in the Contract.

GP-45 DEFAULT AND TERMINATION OF CONTRACT

The Owner shall submit a written notice to the Contractor and Surety which justifies placement of the Contractor in default if:

45.1 The Work is not begun within the time specified in the Notice to Proceed; or

45.2 The Work is performed with insufficient workmen, equipment, or materials to assure prompt completion; or

45.3 The Contractor performs unsuitable, neglected or rejected work, refuses to remove materials; or

45.4 The Work is discontinued; or

45.5 The Work is not completed within the Contract Time or time extension; or

45.6 Work is not resumed within a reasonable time after receiving a notice to continue; or

45.7 The Contractor becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency; or

45.8 The Contractor allows any final judgment to stand unsatisfied for a period of ten (10) days; or

45.9 The Contractor makes an assignment for the benefit of creditors; or

45.10 The Work is not performed in an acceptable manner.

If the Contractor or Surety does not remedy all conditions cited in the written notice within ten (10) days after receiving such a notice, the Contractor will be in default and the Owner shall remove the Contractor from the Work. If the Contractor is
placed into default, the Owner may obtain the necessary labor, materials, and equipment or enter into a new Agreement and Contract in order to complete the Work. All costs incurred by the Owner for completing the Work under the new Contract will be deducted from the payment due the Contractor. If the expense exceeds the sum payable under the Contract, the Contractor and Surety shall be liable to pay the Owner the difference.

GP-46 TEMPORARY SUSPENSION OF WORK

The Engineer shall have the authority to temporarily suspend the Work in whole or in part. A Field Order shall be issued to the Contractor for any of the Work that is suspended for periods exceeding one (1) calendar day. The Field Order shall include the specific reasons and details for the suspension. The Contract Time shall not be extended if the Work is suspended due to failure by the Contractor to comply with a Field Order or with the Plans and Specifications. If the Work is suspended in the interest of the Owner, the Contractor shall make due allowances for the lost time.

GP-47 NON-CONFORMING AND UNAUTHORIZED WORK

Work not conforming to the Plans, Specifications, Field Orders, or Change Orders shall not be accepted for payment. Unacceptable or unauthorized work shall be removed and replaced in an acceptable manner at the expense of the Contractor in order to obtain final acceptance of the Work.

GP-48 CONTRACTOR’S RIGHT TO TERMINATE CONTRACT

The Contractor may terminate the Contract or Work and recover payment from the Owner for labor and materials if the Work is stopped through no act or fault of the Contractor for more than three (3) months. For example, such an occurrence could be caused by a court order or other public authority. In any case, the Contractor shall submit a written notice to the Engineer at the beginning of the occurrence, and a written Claim to the Owner at the end of the occurrence.

GP-49 BREACH OF CONTRACT

The Owner shall submit a written Claim to the Contractor regarding any breach of the Contract. The Contractor must provide a written response to the Owner regarding the breach of Contract within ten (10) days after the Claim. This response must provide either an admission to the Claim or a detailed denial based on relevant data and calculations. The failure of the Contractor to provide a proper response within ten (10) days shall result in justification of the Claim by default.

GP-50 NO WAIVER OF LEGAL RIGHTS

The Owner shall not be prevented from recovering costs from the Contractor, Surety, or both due to failure of the Contractor to fulfill all of the obligations under the Contract. If a waiver is provided to the Contractor for a breach of Contract by the Owner, it shall not apply to any other breach of Contract. Final acceptance of the Work shall not prevent the Owner from correcting any measurement, estimate, or
certificate. The Contractor shall be liable to the Owner without prejudice to the terms of the Contract or any warranty for latent defects, fraud, or gross negligence.

GP-51 LIABILITY FOR DAMAGES AND INJURIES

To the fullest extent permitted by Laws and Regulations, the Contractor shall indemnify and hold harmless the Owner, Engineer, and their affiliates from claims, costs, losses, demands, and judgments (including but not limited to fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) caused by negligence of the Contractor or the Contractor’s affiliates under this Contract, provided that it results in bodily injury, sickness, disease, or death, or in injury to or destruction of tangible property including the loss of use resulting there from.

The indemnification obligations of the Contractor shall not extend to the liability of the Owner, Engineer, and their affiliates arising out of the preparation or approval of the Plans, Specifications, maps, opinions, reports, surveys, or Change Orders, or for providing directions or instructions which are the primary cause of the injury or damage.

Should the Owner or Contractor suffer from any injury or damage due to an error, omission, or act of the other party or their legally liable affiliates, a written Claim shall be submitted to the other party within ten (10) days. The Claim shall provide all details regarding the injury or damage, the results of any investigations, and the action to be taken to prevent any reoccurrence.

GP-52 REQUIRED INSURANCE (KCS AND CN RAILROAD)

Measurement and Payment. No separate measurement shall be made for railroad insurance and shall be paid for at the contract lump sum price for “Railroad Insurance”.

The Contractor shall acknowledge and sign Construction Agreement between Railroad Company and the Government/State.

Before commencing any work under this contract adjacent to or on the premises of Railroad, the Contractor shall procure and maintain in force, so long as work shall continue upon such premises, and at its sole expense, comprehensive general and automobile liability insurance with contractual liability endorsement and products and completed operation hazards included.

The Contractor, if and to the extent that either is performing work on or about Railroad’s property, shall procure and maintain the following insurance policies:

52.1 Commercial General Liability coverage at their sole cost and expense with limits of not less than $5,000,000 in combined single limits for bodily injury and/or property damage per occurrence, and such policies shall name Railroad Company as an additional named insured.
52.2 Statutory Worker’s Compensation and Employers Liability Insurance with limits of not less than $1,000,000, which insurance must contain a waiver of subrogation against Railroad Company and its affiliates.

52.3 Commercial automobile liability insurance with limits of not less than $500,000 combined single limit for bodily injury and/or property damage per occurrence, and such policies shall name Railroad Company as an additional named insured.

52.4 Railroad protective liability insurance with limits of not less than $5,000,000 combined single limit for bodily injury and/or property damage per occurrence and an aggregate annual limit of $10,000,000, which insurance shall satisfy the following additional requirements:

52.4.1 The insurer must be financially stable and rated B+ or better in Best’s Insurance Reports.

52.4.2 The Railroad Protective Insurance Policy must be on the ISO/RIMA Form of Railroad Protective Insurance - Insurance Services Office (ISO) Form CG 00 35.

52.4.3 Railroad Company Transportation must be named as the named insured on the Railroad Protective Insurance Policy.

52.4.4 Name and Address of the Contractor must be shown on the Declarations page.

52.4.5 Description of operations must appear on the Declarations page and must match the Project description, including project or contract identification numbers.

52.4.6 Authorized endorsements must include the Pollution Exclusion Amendment - CG 28 31, unless using form CG 00 35 version 96 and later.

52.4.7 Authorized endorsements may include:

   a. Broad Form Nuclear Exclusion - IL 00 21
   b. 30-day Advance Notice of Non-renewal or cancellation
   c. Required State Cancellation Endorsement
   d. Quick Reference or Index - CL/IL 240

52.4.8 Authorized endorsements may not include:

   a. A Pollution Exclusion Endorsement except CG 28 31
   b. A Punitive or Exemplary Damages Exclusion
   c. A “Common Policy Conditions” Endorsement
   d. Any endorsement that is not named in Section (d)(vi) or (d)(vii) above.
   e. Policies that contain any type of deductible
52.4.9 The Contractor must submit its original insurance policies and two (2) copies and all notices and correspondence regarding the insurance policies to KCS and CN Railroad Companies’ Legal Administrators.

The Contractor shall not begin work on the Project until it has received KCS and CN’s written approval of the required insurance policies.

GP-53 WORK ON OR ADJACENT TO RAILROAD (KCS AND CN)

All Federal Railroad Administration (FRA) requirements shall be adhered to by the Contractor. All Railroad Companies’ recommended actions shall be submitted to the Government Representative for approval. The Contractor shall retain the services of a Professional Engineer, licensed in the state of Louisiana, to accomplish the work described below. The following will apply to contract operations on or adjacent to the premises of KCS and CN Railroads’ property rights-of-way:

53.1 Measurement and Payment. No separate measurement shall be made for railroad services (railroad training, flagmen and watchman services and inspection services) and payment shall be made for at the contract lump sum price for “Railroad Services”.

53.2 Work within Railroads Rights-of-Way. The Contractor shall not commence any work on Railroads property or rights-of-way until it has complied with the following conditions:

53.2.1 Before commencing any work under the contract whether on or adjacent of the rights-of-way of KCS and CN Railroads, the Contractor and applicable subcontractors shall procure and keep in effect during the period of such work, at the Contractor's own cost and expense insurance in accordance with the above General Provision entitled "REQUIRED INSURANCE (RAILROAD)."

53.2.2 The Contractor shall, before entering upon the premises of Railroad Company, shall notify, in writing, both the Government Representative and Railroad Company to make arrangements to secure written permission from an authorized representative of Railroad Company for the use and occupancy of its premises. The notification shall contain the date that it intends to commence work on the Project. The Contractor shall confer with officials of Railroad Company relative to its requirements for clearances, operation and general regulations. Such notice must be received by Railroad Company at least ten business days in advance of the date the Contractor proposes to begin work on Railroad Company property. The notice must refer to the Construction Agreement by date executed by Railroad Company and the Owner.

53.2.3 If flagging service is required, such notice shall be submitted at least thirty (30) business days in advance of the date scheduled to commence the Work.
53.2.4 Obtain authorization from the Railroad Company Representative to begin Work on their property, such authorization to include an outline of specific conditions with which it must comply.

53.2.5 Obtain from Railroad Company the names, addresses and telephone numbers of Railroad Company’s personnel who must receive notice under provisions in the Agreement. Where more than one individual is designated, the area of responsibility of each shall be specified.

53.3 Required Training. Prior to beginning work, all personnel working on or adjacent to the Railroad shall complete E-rail training (Internet) and Railroad worker Protection Training and undergo a background check. The E-rail training and background check will be conducted through the following web site www.e-railsafe.com. There is a $99 cost to use the web site and a $50 cost for each ID badge issued. Time from entering the web site to issuing the ID badge is approximately 8 days. In addition, the contractor’s personnel shall be required to receive the annual Railroad Company’s Training before entering the railroad right of way.

53.4 Construction Schedule. Prior to beginning work, the Contractor shall submit a construction schedule for:

- demolition of the existing structures
- any construction work within 50 feet of the centerline of the Railroad tracks.

53.5 General

53.5.1 Construction work on Railroad property shall be subject to Railroad’s inspection and approval.

53.5.2 Construction work on Railroad property shall be in accordance with Railroad’s written outline of specific conditions and with these Special Provisions.

53.5.3 Contractor shall observe the terms and rules of the Railroad SafeWay Manual, which the Contractor shall be required to obtain from Railroad Company, and in accordance with any other instructions furnished by Railroad Company’s Representative to the Government Representative.

53.5.4 The Contractor shall fully coordinate his/her work with the operations of Railroad Company.

53.5.5 The Contractor shall perform all work adjacent to or on the property of Railroad so as not to interrupt or delay the operation of trains over the tracks in use, or to interfere with communications and signal lines adjacent to said tracks or upon said premises except under arrangements between the Contractor and Railroad Company. The length of interruption shall be determined from the construction activities. During the progress of such work, the Contractor shall
maintain liaison with Railroad's officers and representatives as may be designated by Railroad so as to ascertain the time of passage of trains at the site of the work, and to clear the railroad tracks and facilities of men, equipment and obstructions to permit free flow of railroad traffic. In the event the Contractor requires a crossing of Railroad Company's right-of-way and tracks at other than a public crossing with its machinery or equipment incident to the contract, the Contractor shall first enter into an agreement satisfactory to Railroad Company setting forth the terms and conditions with respect to the establishment, use, and removal of such crossing.

53.5.6 The Contractor shall, at all times during the period of construction, keep the railroad tracks and roadbed free of materials, earth, mud, rocks and other debris.

53.5.7 The Contractor shall keep all equipment, tools and materials stored at least 25 feet from the centerline of any usable track. Explosives or other highly flammable substances shall not be stored on Railroad Property’s right-of-way.

53.5.8 The Contractor shall remove all tools, equipment and materials from Railroad Company's premises promptly upon completion of work, restoring premises to the same state and condition as when the Contractor entered thereon.

53.5.9 The Contractor shall remove any liens against Railroad Company's property arising from performance of work hereunder by the Contractor or any subcontractor.

53.6 Construction Activities Across the Railroad

53.6.1 If the Contractor requires access across Railroad Company tracks incident to construction of the Project, the Contractor must first obtain the permission of Railroad Company and shall execute a license agreement or right of entry satisfactory to Railroad Company, wherein the Contractor agrees to bear all costs and liabilities related to such access.

53.7 Flagging Protection and Watchman Services

53.7.1 Railroad Company has sole authority to determine the need for flagging required to protect its operations and property. In general, flagging protection will be required whenever the Contractor or their equipment are, or are likely to be, working within fifty (50) feet of live track or other track clearances specified by Railroad Company, or over tracks. The Contractor shall be responsible for arranging with Railroad Company for flagging protection or watchman service. Flagging or watchman service will also be required whenever boom equipment machinery is working closer to the track centerline than boom length (horizontally extended and at right angles to the track) plus 15-feet.
53.7.2 Flagging Protection Services. If flagging service is required, such notice shall be submitted at least thirty (30) business days in advance of the date scheduled to commence the Work. No work shall be undertaken until said flagman or watchmen are at the job site. The construction activities shall be conducted in a manner to minimize the hours of the flagman.

53.7.3 The Contractor shall reimburse Railroad Company directly for all costs of flagging that is required on account of construction within Railroad Company property shown in the Plans, or that is covered by an approved plan revision, supplemental agreement or change order. The costs for this task shall be included in the applicable bid item.

53.7.4 Railroad Company shall have the right to assign an individual to the site of the Project to perform inspection service whenever, in the opinion of Railroad Company Representative, such inspection may be necessary. The Contractor shall reimburse Railroad Company for the costs incurred by Railroad Company for such inspection service. Inspection service shall not relieve the Contractor from liability for its Work.

53.7.5 Railroad Company shall render invoices for, and the Contractor shall pay for, the actual pay rate of the flagpersons and inspectors used, plus standard additives, whether that amount is above or below the rate provided in the Estimate. If the rate of pay that is to be used for inspector or flagging service is changed before the work is started or during the progress of the work, whether by law or agreement between Railroad Company and its employees, or if the tax rates on labor are changed, bills will be rendered by Railroad Company and paid by the Contractor using the new rates. The Contractor shall perform their operations that require flagging protection or inspection service in such a manner and sequence that the cost of such will be as economical as possible.

53.7.6 Watchman Service. The purpose of this service is to insure that Contractor's operations do not damage railroad facilities nor foul operations unless flagging service has been arranged. The watchman assigned will flag trains if they deem necessary, but such service is intended to eliminate the need of unplanned flagging. Such service will be required at all times that work is done (or crane boom can fall) within 15-feet of centerline of track when any work is done adjacent to track or when work is done above any track. In general, one watchman for each railroad track will be expected to cover work for this project. Work more widely scattered will require additional watchmen.

53.8 Demolition Procedure Over and Adjacent to Railroad

The Contractor shall submit to the Government Representative and Railroad Company, a detailed procedure for demolition of the structure over or
adjacent to Railroad Tracks.

53.8.1 The Contractor shall submit the detailed procedure for demolition of existing structures over or adjacent to Railroad Company’s tracks or right-of-way. This procedure shall include a plan showing the locations of cranes, horizontally and vertically, operating radii, with loading or disposal locations shown, with all dimensions referenced from the center line of the near track, including beam placement on ground or truck loading staging plan. The plan shall also include the location, with relevant dimensions, of all tracks, other railroad facilities; wires, poles, adjacent structures, or buried utilities that could be affected, showing that the proposed lifts are clear of these obstructions should be shown. No crane or equipment may be set on the Railroad Company rails or track structure and no material may be dropped on Railroad Company property.

53.8.2 Also included with this submittal the following information:

(a) Computations showing weight of picks must be submitted. Computations shall be made from field verified plans of the existing structure beams being removed and those plans or sections thereof shall also be included in the submittal; the weight shall include the weight of concrete or other materials including lifting rigging.

(b) If the Contractor can prove to Railroad Company that plans do not exist and weights must be calculated from field measurements, the field measurements are to be made under the supervision of a Professional Engineer, licensed in the state of Louisiana, submitting the procedure and shall include sketches and estimated weight calculations with the procedure. If possible, field measurements shall be taken with a Railroad Company representative present.

(c) Crane rating sheets showing cranes to be adequate for 150% of the actual weight of the pick. A complete set of crane charts, including crane, counterweight, maximum boom angle, and boom nomenclature is to be submitted. Safety factors that may have been “built in” to the crane charts are not to be considered when determining the 150% Factor of Safety.

(d) A data sheet shall be prepared listing the type, size and arrangements of slings, shackles, or other connecting equipment. Include copies of a catalog or information sheets for specialized equipment. All specific components proposed for use shall be clearly identified and highlighted in the submitted documents. The safe working load capacity of the connecting equipment shall be 150% above the calculated weight of the pick.
(e) A complete written procedure is to be included that describes the sequence of events, indicating the order of lifts and any repositioning or rehitching of the crane or cranes.

(f) A time schedule for each of the various stages must be shown as well as a schedule for the entire lifting procedure. The proposed time frames for all critical subtasks (i.e., torch/saw cutting various portions of the superstructure or substructure, dismantling splices, installing temporary bracing, etc.) shall be furnished so that the potential impact(s) to Railroad operations may be assessed and eliminated or minimized.

(g) The names and experience of the key Contractor personnel involved in the operation shall be included in the Contractor’s means and methods submission.

(h) Design and supporting calculations prepared by the Professional Engineer for items including the temporary support of components or intermediate stages shall be submitted for review.

(i) Existing, obsolete, bridge piers, or piles shall be removed to a minimum of 3’-0” below the finished grade, final ditch line invert, or as directed by the Engineer.

(j) A minimum quantity of 25 Tons of Railroad approved track ballast may be required to be furnished and stockpiled on site by the Contractor, or as directed by the Engineer.

(k) Railroad Company’s tracks, signals, structures, and other facilities shall be protected from damage during demolition of existing structure or replacement of deck slab. On-track or ground level debris shields such as crane mats are prohibited for use by Railroad.

53.9 Vertical Demolition Debris Shield.

This type of shield shall be required for substructure removals in close proximity to Railroad track and other facilities, as determined by the Government Representative and Railroad Company.

53.9.1 Prior to commencing the demolition activity, the Contractor shall install a ballast protection system consisting of geotextile to keep the railroad ballast from becoming fouled with construction or demolition debris and fines. The geotextile ballast protection system shall be installed and maintained by the Contractor for the project duration or with additional measures as directed by the Government Representative and Railroad Company.

53.9.2 The Contractor, shall submit detailed plans, with detailed calculations, prepared and submitted by a Professional Engineer,
licensed in the state of Louisiana, of the protection shield and ballast protection systems for approval prior to the start of demolition.

53.9.3 Blasting will not be permitted over or within Railroad Company’s right-of-way.

53.10 Excavation and Shoring Procedures Adjacent to Railroad Property

The Contractor shall submit a detailed procedure for the installing sheeting/shoring adjacent to Railroad Tracks. The Contractor shall notify the Government Representative and Railroad Company five (5) working days prior to beginning shoring so that the Government Representative and a Railroad Company Representative can be present to observe any track movement or displacement. If movement, displacement or damage occurs, Railroad Company will immediately notify the Government Representative to stop shoring work.

53.10.1 Shoring protection shall be provided when excavating adjacent to an active track or railroad facility or as determined by Railroad Company. Shoring will be provided in accordance with AREMA Manual for Railway Engineering Chapter 8, part 28; except as noted below.

53.10.2 Shoring may not be required if all of the following conditions are satisfied:

(a) Excavation does not encroach upon a 1½ horizontal: 1 vertical theoretical slope line starting 1’-6” below top of rail and at 12’-0” minimum from centerline of the track (live load influence zone).

(b) Track is on level ground or in a cut section and on stable soil.

(c) Excavation does not adversely impact the stability of a Railroad facility (i.e. signal bungalow, drainage facility, undergrade bridge, building, etc.).

(d) Shoring is not required by any governing construction code.

53.10.3 When the track is on an embankment, excavating the toe of the embankment without shoring may affect the stability of the embankment. Therefore, excavation of the embankment toe without shoring will not be permitted.

53.10.4 Trench boxes are prohibited for use on Railroad Property within the theoretical railroad live load influence zone.

53.10.5 The required protection is the cofferdam type that completely encloses the excavation. Where dictated by conditions, partial cofferdams with open sides away from the track may be used. Cofferdams shall be constructed using steel sheet piling, or when
approved by the engineer, steel soldier piles with timber lagging. Wales and struts shall be provided and designed as needed. The following shall be considered when designing cofferdams:

(a) Shoring shall be designed to resist a vertical live load surcharge of 1,880 lbs. per square foot, in addition to active earth pressure. The surcharge shall be assumed to act on a continuous strip, 8 feet-6” inches wide. Lateral pressures due to surcharge shall be computed using the strip load formula shown in AREMA Manual for Railway Engineering, Chapter 8, Part 20.

(b) Allowable stresses in materials shall be in accordance with AREMA Manual for Railway Engineering, Chapter 7, 8, and 15.

(c) A construction procedure for temporary shoring shall be shown on the drawing.

(d) All shoring systems on or adjacent to Railroad right-of-way shall be equipped with railings or other approved fall protection.

(e) A minimum horizontal clearance of 10 feet-0” inches from centerline of the track to face of nearest point of shoring shall be maintained provided a 12 feet-0” inches roadbed is maintained with a temporary walkway and handrail system.

53.10.6 The Contractor shall submit the following drawings and calculations (all shall be signed/sealed by a Professional Engineer in the state of Louisiana) for Railroad Company’s review and approval.

(a) Six (6) sets of detailed drawings of the shoring systems showing sizes of all structural members, details of connections, and distances from centerline of track to face of shoring. Drawing shall show a section showing height of shoring and track elevation in relation to bottom of excavation.

(b) Six (6) sets of calculations of the shoring design.

(c) The drawings and calculations shall be prepared by a Licensed Professional Engineer in the State of Louisiana is to be constructed and shall bear his seal and signature. Shoring plans shall be approved by Railroad Company’s construction engineering and inspection representative.

(d) For sheeting and shoring within 18 feet-0 inches of the centerline of the track, the live load influence zone, and in
slopes, the Contractor shall use hot-rolled interlocked steel sheeting (sheet pile).

(e) Sheet pile installed in slopes or within 18 feet-0 inches of the centerline of track shall not be removed.

(f) Sheet piles shall be cut off a minimum of 3 feet-0 inches below the finished grade, ditch line invert, or as directed by Railroad Company through the Contacting Officer. The ground shall be backfilled and compacted immediately after sheet pile is cut off.

(g) A procedure for cutting off the sheet pile and restoring the embankment shall be submitted to the Government Representative for review and acceptance.

GP-54 LIABILITY FOR LOSSES BY ACTS OF THE GOVERNMENT

The Owner shall not be liable for any loss or damage suffered by the Contractor arising out of a cessation of Work under this Contract due to any act or order of any local, state, or federal government agency. If this cessation occurs, the Contractor may request an extension of the Contract Time according to the provisions in paragraph “EXTENSION OF CONTRACT TIME”.

GP-55 FINAL INSPECTION AND ACCEPTANCE

The Engineer, Owner, and Contractor shall perform a final inspection after receiving written notice from the Contractor that all of the Work is complete. If the Work is determined to be unsatisfactory, the Engineer shall notify the Contractor in writing of the deficiencies and recommended corrective actions.

Unfulfilled work or damages caused by the negligence of the Contractor or Subcontractors shall be repaired or corrected at the expense of the Contractor. All other damages to the Work which received previous acceptance by the Engineer shall be repaired at the expense of the Owner. Upon completion of the repairs or corrections, the Engineer, Owner, and Contractor shall perform another inspection. The Engineer shall submit a written notice of acceptance to the Owner after the Work has been determined to be satisfactorily completed according to the Contract.

GP-56 AS-BUILT DRAWINGS

The Contractor shall submit all originals and two (2) copies of the As-Built Drawings to the Engineer for review and acceptance in accordance with the Special Provisions. The As-Built Drawings shall provide complete data for quantities, dimensions, specified performance and design criteria, and similar items which clearly represent the services, materials, and equipment the Contractor has provided. All revision sheets shall be clearly stamped with the words “As-Built”.
GP-57 COMPLETION OF CONTRACT

Completion of the Contract requires all of the Work to be complete, inspected by the Engineer, accepted by the Owner as recommended by the Engineer, and after, final payment is made. After the Contract is complete, the Contractor will then be released from further obligation except as set forth in the Contract Bond and Contractor’s Guarantee.

GP-58 CONTRACTOR’S GUARANTEE

The Contractor is obligated to provide a written guarantee to the Owner that all of the Work conforms to the Contract Documents. The Work shall be guaranteed to survive for a minimum period of one (1) year after final acceptance, unless otherwise specified in the Technical Specifications.

58.1 The guarantee shall include:

58.1.1 A written warranty by the manufacturer for each piece of installed project equipment or apparatus furnished under the Contract.

58.1.2 Any necessary repair of replacement of the warranted equipment during the guarantee period at no cost to the Owner.

58.1.3 Satisfactory operation of installed equipment including, but not limited to, any mechanical and electrical systems furnished and constructed under the Contract during the guarantee period. The Contractor shall repair all equipment which fails due to defective materials or faulty workmanship during the guarantee period. The Contractor shall also be liable for all other ancillary expenses incurred by the Owner due to the failure.

58.2 The guarantee shall exclude defects or damage caused by:

58.2.1 Abuse or improper modification, maintenance, or operation by anyone other than the Contractor; or

58.2.2 Wear and tear under normal usage.

58.3 This obligation by the Contractor shall be absolute. The following actions will not constitute acceptance of non-conformance Work or release the Contractor from obligation to furnish the Work in accordance with the Contract Documents:

58.3.1 Observations by the Owner or Engineer; or

58.3.2 Recommendations by the Engineer or payment by the Owner; or

58.3.3 Use of the Work by the Owner; or
58.4 Issuance of a notice of acceptance by the Owner pursuant to the provisions of paragraph “FINAL INSPECTION AND ACCEPTANCE”, or failure to do so; or

58.4.1 Any inspection, test, or approval by others; or

58.4.2 Any correction to non-conforming work by the Owner.
# STANDARD GENERAL CONDITIONS

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

A. Wherever used in the Contract Documents and printed with initial or all capital letters, the terms listed below shall have the meanings indicated which are applicable to both the singular and plural thereof.

1. Addenda--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the Contract Documents.

2. Agreement--The written instrument which is evidence of the agreement between OWNER and CONTRACTOR covering the Work.

3. Application for Payment--The form acceptable to ENGINEER which is to be used by CONTRACTOR during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. Asbestos--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. Bid--The offer or proposal of a bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. Bidding Documents--The Bidding Requirements and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

7. Bidding Requirements--The Advertisement or Invitation to Bid, Instructions to Bidders, Bid security form, if any, and the Bid form with any supplements.

8. Bonds--Performance and payment bonds and other instruments of security.

9. Change Order--A document recommended by ENGINEER which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, subject to and in accordance with the applicable Laws and Regulations and issued on or after the Effective Date of the Agreement.

10. Claim--A demand or assertion by OWNER or CONTRACTOR seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
11. **Contract**--The entire and integrated written agreement between the OWNER and CONTRACTOR concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. **Contract Documents**--The Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR’s Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER’s written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

13. **Contract Price**--The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.03 in the case of Unit Price Work).

14. **Contract Times**--The number of days or the dates stated in the Agreement to: (i) achieve Substantial Completion; and (ii) complete the Work so that it is ready for final payment as evidenced by ENGINEER’s written recommendation of final payment.

15. **CONTRACTOR**--The individual or entity with whom OWNER has entered into the Agreement.

16. **Cost of the Work**--See paragraph 11.01.A for definition.

17. **Drawings**--That part of the Contract Documents prepared or approved by ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

18. **Effective Date of the Agreement**--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. **ENGINEER**--The individual or entity named as such in the Agreement.

20. **ENGINEER’s Consultant**--An individual or entity having a contract with ENGINEER to furnish services as ENGINEER’s independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.
21. **Field Order**--A written order issued by ENGINEER which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

22. **General Requirements**--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

23. **Hazardous Environmental Condition**--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

24. **Hazardous Waste**--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

25. **Laws and Regulations; Laws or Regulations**--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. **Liens**--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

27. **Milestone**--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

28. **Notice of Award**--The written notice by OWNER to the apparent successful bidder stating that upon timely compliance by the apparent successful bidder with the conditions precedent listed therein, OWNER, if OWNER decides to proceed with the Work, shall sign and deliver the Agreement to the successful bidder. However, the Notice of Award shall not be construed as an agreement, meeting of the minds, contract, or any other legal obligation between the OWNER and CONTRACTOR. Until the CONTRACTOR receives a Notice to Proceed from the OWNER, the CONTRACTOR has no right or remedy against the OWNER.

29. **Notice to Proceed**--A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times shall commence to run and on which CONTRACTOR shall start to perform CONTRACTOR’s obligations and the Work under the Contract Documents.

30. **OWNER**--The individual, entity, public body, or authority with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

31. **Partial Utilization**--Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

32. **PCBs**--Polychlorinated biphenyls.

33. **Petroleum**--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square
inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

34. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part as may be indicated elsewhere in the Contract Documents.

35. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

36. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

37. *Resident Project Representative*--The authorized representative of ENGINEER, OWNER, or an independent contractor who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work shall be judged.

39. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

40. *Site*--Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of CONTRACTOR.

41. *Specifications*--That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.

42. *Subcontractor*--An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

43. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER, as evidenced by ENGINEER's issued and signed Certificate of Substantial Completion, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.

44. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.
45. **Supplier**—A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

46. **Underground Facilities**—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

47. **Unit Price Work**—Work to be paid for on the basis of unit prices.

48. **Work**—The entire completed construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

49. **Work Change Directive**—A written statement to CONTRACTOR issued on or after the Effective Date of the Agreement and recommended by ENGINEER and signed by OWNER ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive shall not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive shall be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

50. **Written Amendment**—A written statement modifying the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

**1.02 Terminology**

A. **Intent of Certain Terms or Adjectives**

1. Whenever in the Contract Documents the terms “as allowed,” “as approved,” or terms of like effect or import are used, or the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of ENGINEER as to the Work, it is intended that such action or determination shall be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the performance
of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

B. Day

1. The word “day” shall constitute a calendar day of 24 hours measured from midnight to the next midnight.

C. Defective

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.04 or 14.05).

D. Furnish, Install, Perform, Provide

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, “provide” is implied.

E. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS AND CERTIFICATES OF INSURANCE

2.01 Delivery of Bonds

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish. CONTRACTOR shall also deliver to the OWNER, with copies to each additional insured identified
herein or in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which OWNER or any additional insured may reasonably request) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.04.

2.02 Copies of Documents

A. OWNER shall furnish to CONTRACTOR six copies of the Contract Documents. Additional copies shall be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

A. The Contract Times shall commence to run on the day indicated in the Notice to Proceed. The OWNER shall issue a Notice to Proceed in accordance with La. R.S. 38:2215. In no event shall OWNER have any obligations or duties to CONTRACTOR under the Agreement until the Notice to Proceed is given to CONTRACTOR. In no event shall the Contract Times commence to run later than the one hundred twentieth day after the day of Bid opening or the thirtieth day after the Effective Date of Agreement, whichever date is later, unless the parties otherwise agree.

2.04 Starting the Work

A. CONTRACTOR shall start to perform the Work within ten days from the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 Before Starting Construction

A. CONTRACTOR’s Review of Contract Documents:–The grades, elevations, dimensions, locations, and field measurements or any drawings or specifications issued by the ENGINEER, or the Work installed by other contractors, are not guaranteed by the ENGINEER or the OWNER. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify the accuracy of all grades, elevations, dimensions, locations, and field measurements. In all cases of the interconnection of Work with existing or other Work, CONTRACTOR shall verify at the Site all dimensions relating to such existing or other Work. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby. Any errors due to the CONTRACTOR's failure to verify all such grades, elevations, locations, dimensions, or field measurements shall be promptly rectified by CONTRACTOR without any additional costs to OWNER or extensions of Contract Times.

B. Preliminary Schedules: Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for its timely review:
1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary schedule of Shop Drawing and Sample submittals which shall list each required submittal and the times for submitting, reviewing, and processing such submittal; and

3. a preliminary schedule of values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices shall include an appropriate amount of overhead and profit applicable to each item of Work.

4. The construction schedule shall be in a detailed precedence-style critical path method (CPM) or prima vera type format satisfactory to the OWNER and the ENGINEER, and shall also: (1) provide a graphic representation of all activities and events that shall occur during the performance of the Work; (2) identify each phase of construction and occupancy; and (3) set forth dates that are critical in insuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents (hereinafter referred to as Milestone Dates). Upon review and acceptance by the OWNER and the ENGINEER of the Milestone Dates, the construction schedule shall be deemed part of the Contract Documents and attached to the agreement as an Exhibit. If not accepted, the construction schedule shall be promptly revised by the CONTRACTOR in accordance with the recommendations of the OWNER and the ENGINEER and resubmitted for acceptance.

C. Evidence of Insurance: -CONTRACTOR shall not start any Work at the Site unless and until CONTRACTOR has in place and in full force and effect all of the insurance and Bonds which the CONTRACTOR is required to obtain by the Agreement, the Contract, or the Supplementary Conditions. Any delay in obtaining confirmation of the existence of the insurance, Bonds, and other security required by this Contract and compliance with the terms of the Contract therefor shall be counted as workdays if the start of Work is delayed beyond the time set forth in paragraph 2.04.A. The Contract shall not be in force or binding on OWNER until satisfactory Bonds and insurance have been provided in accordance with the Contract Documents.

D. In accordance with the Instructions to Bidders, one complete copy of the executed Contract Documents, including Specifications and Drawings, shall be filed with the Clerk of Court and Ex Officio Recorder of Mortgages for St. John The Baptist Parish promptly, but in any event before starting any Work, at CONTRACTOR’S expense, which expense may be deducted from any application for payment if not paid for directly by CONTRACTOR.

2.06 Preconstruction Conference

A. After the effective date of the Agreement and prior to the time the Contract Times start to run, and before any Work at the Site is started, a conference attended by CONTRACTOR, OWNER, ENGINEER, and others as appropriate shall be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.05.B, procedures for
handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 Initial Acceptance of Schedules

A. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER, and others as appropriate shall be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.05.B. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until acceptable schedules are submitted to ENGINEER.

1. The progress schedule shall be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within any specified Milestones and the Contract Times. Such acceptance shall not impose on ENGINEER responsibility for the progress schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR’s full responsibility therefor.

2. CONTRACTOR’s schedule of Shop Drawing and Sample submittals shall be acceptable to ENGINEER if it provides a workable arrangement for reviewing and processing the required submittals.

3. CONTRACTOR’s schedule of values shall be acceptable to ENGINEER as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result shall be provided whether or not specifically called for at no additional cost to OWNER.

C. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in Article 9.

D. In the event of an inconsistency in the Contract Documents, the order of precedence shall be as follows:
A. Agreement
B. Addenda/Change Orders/Written Amendment
C. CONTRACTOR’s Bid
D. Supplementary Conditions
E. General Conditions
F. Invitation to Bid
G. Instructions to Bidders
I. Referenced Standard Specifications
J. Drawings

With reference to the Drawings, the order of precedence is as follows: Figures govern over scaled dimensions; detail drawings over general drawings; addenda/change order drawings govern over standard drawings and shop drawings.

E. OWNER makes no warranties, express or implied, with respect to the fitness of the Drawings or Specifications prepared by the ENGINEER or any other person, and CONTRACTOR waives any claims against OWNER arising out of any implied or express warranties of the fitness of the Drawings or Specifications for their intended purpose."

3.02 Reference Standards

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of OWNER, CONTRACTOR, or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to OWNER, ENGINEER, or any of ENGINEER’s Consultants, agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

1. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR
shall report it to ENGINEER in writing at once. CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as required by paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.04; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity, or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

   a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

   b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Amending and Supplementing Contract Documents

A. The Contract Documents can only be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways: (i) a Written Amendment; (ii) a Change Order; or (iii) a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways: (i) a Field Order; (ii) ENGINEER’s approval of a Shop Drawing or Sample; or (iii) ENGINEER’s written interpretation or clarification. Any variations and deviations in the Work arising from any of the methods set forth in paragraph 3.04.B. shall not authorize an amendment to the Contract Price or Contract Times. The sole method to amend the Contract Price or Contract Times is pursuant to paragraph 3.04.A.

3.05 Reuse of Documents

A. CONTRACTOR and any Subcontractor or Supplier or other individual or entity performing or furnishing any of the Work under a direct or indirect contract with OWNER: (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER’s Consultant, including electronic media editions; and (ii) shall not reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER. This prohibition shall survive final payment, completion, and acceptance of the Work, or termination or completion of the Contract. Nothing herein shall preclude CONTRACTOR from retaining copies of the Contract Documents for record purposes.
ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

4.01 Availability of Lands

A. OWNER shall furnish the Site. OWNER shall notify CONTRACTOR of any encumbrances or restrictions not of general application but specifically related to use of the Site with which CONTRACTOR must comply in performing the Work. OWNER shall obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If CONTRACTOR and OWNER are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in OWNER’s furnishing the Site, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

B. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER’s interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 Subsurface and Physical Conditions

A. Reports and Drawings: The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that ENGINEER has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Contract Documents.

B. Limited Reliance by CONTRACTOR on Technical Data Authorized: CONTRACTOR may rely upon the general accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER, or any of ENGINEER’s Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

F. The CONTRACTOR and each Subcontractor shall evaluate and satisfy themselves as to the Site conditions and limitations under which the Work is to be performed, including, without limitation, (1) the location, condition, layout, and nature of the Project Site and surrounding areas; (2) generally prevailing climactic conditions; (3) anticipated labor, supply, and costs; (4) availability and cost of materials, tools, and equipment; and (5) other similar issues. The OWNER assumes no responsibility or liability for the physical condition or safety of the Project Site or any improvements located on the Project Site. Except as set forth in Article 4, the CONTRACTOR shall be solely responsible for providing a safe place for the performance of the Work. The OWNER shall not be required to make adjustments in either the Contract Price or Contract Times arising from a failure by the CONTRACTOR or any Subcontractor to comply with the requirements of this paragraph.

4.03 Differing Subsurface or Physical Conditions

A. Notice: If CONTRACTOR discovers or should have discovered that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any “technical data” on which CONTRACTOR is entitled to rely as provided in paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then CONTRACTOR shall, immediately and in any event within 48 hours after the time the CONTRACTOR discovers and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. ENGINEER’s Review: After receipt of written notice as required by paragraph 4.03.A, ENGINEER shall promptly review the pertinent condition, determine the necessity of OWNER’s obtaining additional exploration or tests with respect thereto, and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER’s findings and conclusions.
C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, shall be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in CONTRACTOR’s cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must meet any one or more of the categories described in paragraph 4.03.A; and

   b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price shall be subject to the provisions of paragraphs 9.08 and 11.03.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

   c. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in paragraph 10.05. However, OWNER, ENGINEER, and ENGINEER’s Consultants shall not be liable to CONTRACTOR for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.04 Underground Facilities

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities, including OWNER, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

   1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and
2. the cost of all of the following shall be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

   a. reviewing and checking all such information and data,

   b. locating all Underground Facilities shown or indicated in the Contract Documents,

   c. coordination of the Work with the owners of such Underground Facilities, including OWNER, during construction, and

   d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, CONTRACTOR shall, immediately and in any event within 24 hours after CONTRACTOR discovers and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER shall promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

   2. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order shall be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price of Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, OWNER or CONTRACTOR may make a Claim therefor as provided in paragraph 10.05. However, OWNER, ENGINEER, and ENGINEER’s Consultants shall not be liable to CONTRACTOR for any claims, costs, losses, or damages incurred or sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.05 *Reference Points*

A. ENGINEER shall provide engineering surveys to establish reference points for construction which in ENGINEER’s judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the
established reference points and property monuments, and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 **Hazardous Environmental Condition at Site**

A. **Reports and Drawings:** Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the ENGINEER in the preparation of the Contract Documents.

B. **Limited Reliance by CONTRACTOR on Technical Data Authorized:** CONTRACTOR may rely upon the general accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER or any of ENGINEER’s Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any CONTRACTOR interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions or information.

C. CONTRACTOR must take all precautions to discover and locate any Hazardous Environmental Condition at the Site that may present a substantial danger to persons or property exposed thereto in connection with the Work at the Site. CONTRACTOR shall be responsible for any damages arising out of or caused by a Hazardous Environmental Condition created on the Site by CONTRACTOR, a Subcontractor, Supplier, or anyone else for whom CONTRACTOR is responsible. Within 24 hours of the time CONTRACTOR discovers the Hazardous Environmental Condition, CONTRACTOR shall follow the procedures set forth in paragraph 4.06.D.

D. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.16); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the
necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. CONTRACTOR shall not be required to resume Work in connection with such condition or in any affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by CONTRACTOR, either party may make a Claim therefor as provided in paragraph 10.05.

F. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER’s Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.F shall obligate CONTRACTOR to indemnify any individual or entity from and against the consequences of that individual’s or entity’s own negligence.

G. The provisions of paragraphs 4.02, 4.03, and 4.04 are not intended to apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

A. CONTRACTOR shall purchase and furnish performance and payment Bonds, each in an amount at least equal to 100 percent of the Contract Price including, but not limited to, the obligations for actual damages and liquidated damages in accordance with the provisions in the Agreement regarding delay in completion of the Work within the Contract Times as security for the faithful performance and payment of all CONTRACTOR’s obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Contract Documents.

B. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed only by sureties meeting the requirements set forth in La. R.S. 38:2218 and 2219 and any other requirements and qualifications set forth in the Supplementary Conditions. All Bonds signed by an agent must be accompanied by a certified copy of such agent’s authority to act.
C. If the surety on any Bond furnished by CONTRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.01.B, CONTRACTOR shall within 20 days thereafter substitute another Bond and surety, both of which shall comply with the requirements of paragraphs 5.01.B and 5.02.

D. Performance Bond

Any surety bond written for a St. John The Baptist Parish Public Works project shall be written by a surety or insurance company currently on the U.S. Department of Treasury Financial Management Service list of approved bonding companies which is published annually in the Federal Register, or by a Louisiana domiciled insurance company with at least an A rating in the latest printing of the A.M. Best's Key Rating Guide to write individual bonds up to ten percent of policyholder's surplus as shown in the A.M. Best's Key Rating Guide or by a surety company that complies with the requirements of LSA-R.S. 38:2219.

No surety shall be accepted from a bondsman which does not have a permanent agent or representative in the State upon whom notices referred to in the General Conditions may be served. The Bond shall be countersigned by a person who is contracted with the surety or Bond Insurer and who is licensed as an insurance agent in this State, and who is residing in this State. Service of said notice on said agent or representative in the State shall be equal to service of notice on the president of the surety, or such other officer as may be concerned. Should the CONTRACTOR's surety, even though approved and accepted by the OWNER, subsequently remove its agency or representative from the State or terminates its residency or license in this State or become insolvent, bankrupt, or otherwise fail, the CONTRACTOR shall immediately furnish a new bond from another company approved by the OWNER, at no additional cost to the OWNER. The new bond shall be executed upon the same terms and conditions as the original bond.

E. Alternative Security

On contracts equal to or less than the amount specified in the applicable Laws and Regulations (currently LSA-R.S. 38:2216), performance bonds and labor and materials payment bonds are waived for a CONTRACTOR or Subcontractor who:

(1) Meets the definition and requirements of a "responsible bidder" as set forth below.
(2) Has been operating as the same business for a continuous period of at least three years.
(3) Has been denied a performance bond by an established security firm, for reasons other than that the applicant has a previous history of performance default.
(4) Provides an irrevocable letter of credit, property bond, or other authorized form of security that is acceptable to the OWNER and is in an amount of not less than the amount of the contract for the faithful performance of his duties.

For the purposes of this paragraph, "responsible bidder" shall mean a CONTRACTOR or Subcontractor who has an established business and who has demonstrated the capability to provide goods and services in accordance with the terms of the Contract, plan, and specifications without excessive delays, extensions, cost overruns, or changes for which the CONTRACTOR or
Subcontractor was held to be responsible, and who does not have a documented record of past projects resulting in arbitration or litigation in which such CONTRACTOR or Subcontractor was found to be at fault.

In addition, a "responsible bidder" shall have a negotiable net worth, or shall be underwritten by an entity with a negotiable net worth, which is equal to or exceeds in value the total cost amount of the public contract as provided in the bid submitted by such bidder. All property comprising the negotiable net worth must be pledged and otherwise unencumbered throughout the duration of the contract period.

F. Scope of the Bond and Obligation of the Surety

The CONTRACTOR's surety shall obligate itself to all the terms and covenants of the Contract Documents covering the Work to be performed hereunder. The OWNER reserves the right to order extra work or make changes by altering, adding to, or deducting from the Work under the conditions and in the manner hereinbefore described without notice to the CONTRACTOR's surety and without in any manner affecting the liability of bondsman or releasing it from any of its obligations hereunder.

The Bond shall also secure for the OWNER the faithful performance of the Contract in strict accordance with the plans and specifications and Contract Documents. It shall protect the OWNER against all lien laws of the State and shall provide for payment of reasonable attorney's fees for enforcement of the Contract and institution of concursus proceedings, if such proceedings become necessary. Likewise, it shall provide that if the ENGINEER is put to labor or expense by enforcement of the Contract and institution of concursus proceedings or through delinquency or insolvency of the Contract they shall be equitably paid for such extra expense and services involved.

The surety of the CONTRACTOR shall be and does hereby declare and acknowledge itself by acceptance to be bound to the OWNER as guarantor jointly and in solido with the CONTRACTOR for fulfillment of the foregoing terms including, but not limited to, any provisions for actual or liquidated damages.

5.02 Licensed Sureties and Insurers

A. All Bonds and insurance required by the Contract Documents to be purchased and maintained by CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

B. Insurance Coverage is required to be provided by companies authorized to do business in the State of Louisiana. Insurance is to be placed with insurers with an A.M. Best rating of no less than A:VI. This requirement shall be waived for workers' compensation coverage only for those contractors whose workers' compensation coverage is placed with companies who participate in the State of Louisiana Workers' Compensation Assigned Risk Pool or the Louisiana Worker's Compensation Corporation.
5.03  **Certificates of Insurance**

A. CONTRACTOR shall, at the same time as CONTRACTOR returns the signed copies of the agreement to OWNER, deliver to OWNER, with copies to each additional insured identified herein or in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain and each such certificate shall include the Project name, the Project number, proposal number, and OWNER’s address as identified in the Agreement.

5.04  **CONTRACTOR’s Liability Insurance**

A. CONTRACTOR shall purchase and maintain such liability and other insurance as is provided herein or in the Supplementary Conditions, as is appropriate for the Work being performed and as shall provide protection from claims set forth below which may arise out of or result from CONTRACTOR’s performance of the Work and CONTRACTOR’s other obligations under the Contract Documents, whether it is to be performed by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers’ compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR’s employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR’s employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance so required by this paragraph 5.04 to be purchased and maintained shall:

1. with respect to comprehensive general liability, automobile liability, and umbrella liability, name OWNER as an additional insured, be primary to any insurance carried by the OWNER, and with respect to workers’ compensation only, include a Waiver of Subrogation in favor of the
OWNER and any principals for whom the OWNER is working, including any co-lessors of such principals; and, with respect to all of the foregoing, be subject to the approval of the OWNER;

2. include at least the specific coverages and be written for not less than the limits of liability provided herein or in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering CONTRACTOR’s indemnity obligations under paragraphs 6.07, 6.11, and 6.20;

5. contain a provision or endorsement that the coverage afforded shall not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given by registered or certified mail, return receipt requested, to OWNER and CONTRACTOR and to each other additional insured identified herein or in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.03 shall so provide);

6. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing, or replacing defective Work in accordance with paragraph 13.07;

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified herein or in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter); and

8. include a provision which requires that any communication regarding the insurance, including any communication under 5.04 B.5. above, include the Project name, Project number, proposal number, and OWNER’s address, as identified in the Agreement.

C. The limits of liability for the insurance required by paragraph 5.4 of the General Conditions shall provide the following coverage for not less than the following amounts or greater where required by Laws and Regulations, and any St. John The Baptist Parish resolutions:

1. Workers’ Compensation, etc. under the General Conditions

The CONTRACTOR shall take out and maintain during the life of this contract, Worker's Compensation Insurance for all his employees in any way engaged in this project. As required by Louisiana State Statute exception: employer's liability shall be $1,000,000 per occurrence when work is to be over water and involves maritime exposures, otherwise this limit shall be no less than $500,000 per occurrence.
2. CONTRACTOR’s Comprehensive General Liability Insurance under the General Conditions which shall also include completed operations and product liability coverage:

The CONTRACTOR shall take out and maintain during the life of this contract Comprehensive General Liability Insurance with a combined Single Limit per occurrence for bodily injury and property damage. This insurance shall include coverage for bodily injury and property damage, and indicate on the certificate of insurance the following:

1) Premises - operations;
2) Broad form contractual liability;
3) Products and completed operations;
4) Use of contractors and sub-contractors;
5) Personal Injury;
6) Broad form property damage;
7) Explosion, collapse and underground [XCU] coverage.

NOTE: On the certificate of insurance, under the description of operations, the following wording is required: The aggregate loss limit applies to each project or a copy of ISO Form CG 25 03 [ed. 11-85 or latest form] shall be submitted.

COMBINED SINGLE LIMITS [CSL]
AMOUNT OF INSURANCE REQUIRED: CONTRACTS UP TO $1,000,000 / CONTRACTS OVER $1,000,000

GENERAL CONTRACTS:

EACH OCCURRENCE/MINIMUM LIMITS:
$500,000           /         $1,000,000

NEW CONSTRUCTION/RENOVATIONS:
EACH OCCURRENCE/MINIMUM LIMITS:
$500,000***       /       $1,000,000***
(DEPENDING ON       / (DEPENDING ON
BUILDING VALUE)      BUILDING VALUE)

*** WHILE THE MINIMUM COMBINED SINGLE LIMITS OF $500,000 IS REQUIRED FOR ALL RENOVATIONS, THE VALUE OF THE BUILDING SHALL BE MULTIPLIED BY 10% AND THE INSURANCE REQUIREMENTS SHALL BE INCREASED AT $1,000,000 INTERVALS AND ROUNDED TO THE NEAREST MILLION.  
EXAMPLE:  RENOVATIONS ON A THIRTY-THREE MILLION DOLLAR BUILDING WOULD REQUIRE THREE MILLION DOLLARS, [$3,000,000] MINIMUM COMBINED SINGLE LIMITS OF COVERAGE

The CONTRACTOR shall take out and maintain a policy of Umbrella Liability Coverage in excess of the primary insurance afforded above and including all operations of the CONTRACTOR, with minimum limits of $5,000,000.00.
3. The CONTRACTOR shall take out and maintain during the life of this contract Business Automobile Liability Insurance with a Combined Single Limit of $1,000,000 per Occurrence for bodily injury and property damage, unless otherwise indicated. This insurance shall include for bodily injury and property damage the following coverage:

1) Any automobiles;
2) Owned automobiles;
3) Hired automobiles;
4) Non-owned automobiles.

4. OWNER’s Protective Liability.

The CONTRACTOR shall take out and maintain a policy of OWNER’s Protective Liability for the same limits of liability for bodily injury and property damage liability and conditions as provided hereinabove under "Comprehensive General Liability Insurance".

The cost of this coverage is at the CONTRACTOR's expense.

5. Builder's Risk Insurance

The CONTRACTOR shall take out and maintain Builder's Risk Insurance at his expense, to insure both the OWNER and CONTRACTOR as their interest may appear. These polices must cover for such amount of the work as is determined by the ENGINEER and/or Architect and shall be the all-risk type of coverage. Although the insurance takes account of payments during the course of the construction from the OWNER to the CONTRACTOR, it is understood that the work shall be at the risk of the CONTRACTOR until finally accepted by the OWNER as a whole pursuant to the provisions of the General Conditions. Except as otherwise provided by law, the Parish Attorney’s Office with the concurrence of the Director of Risk Management is authorized to omit in whole or part the insurance requirements of this section in connection with such contracts.

6. Miscellaneous

(a) Deductibles. No insurance required under this contract shall include a deductible in excess of $10,000.00 unless otherwise approved by the Parish Attorney’s Office with the concurrence of the Director Of Risk Management. The cost of all deductible amounts shall be borne by the CONTRACTOR.

(b) If at any time any of the said policies shall be or becomes unsatisfactory to the OWNER as to form or substance; or if a company issuing any such policy shall be or become unsatisfactory to the OWNER, the CONTRACTOR/Subcontractors shall promptly obtain a new policy, submit the same to the OWNER for approval and submit a certificate thereof as provided above.

Upon failure of a CONTRACTOR/Subcontractor to furnish to deliver and maintain such insurance as above provide this Contract, at the election of the OWNER, may be forthwith declared suspended, discontinued or terminated. Failure of the CONTRACTOR/Subcontractor
to take out and/or to maintain insurance shall not relieve the CONTRACTOR/Subcontractor from any liability under the contract, nor shall the insurance requirements be construed to conflict with the obligation of the CONTRACTOR/Subcontractor concerning indemnification.

(c) WAIVER. Except as otherwise provided by law, the coverage requirements of this section may be waived in whole or part on contracts under $100,000.00 and the Chairman of the Council is authorized to use his discretion in regard to insurance requirements for such contracts. Except as otherwise provided by law, the Parish Attorney's Office with the concurrence of the Director of Risk Management is authorized to omit in whole or part the insurance requirements of this section in connection with such contracts.

D. The policies of insurance so required by paragraph 5.04 to be purchased and maintained by CONTRACTOR shall indicate the project number, proposal number, and OWNER's address as identified in the Agreement and shall also include the following clauses:

1. The CONTRACTOR/Sub-contractor insurers shall have no right of recovery or subrogation against the OWNER, it being the intention of the parties that the insurance policy so affected shall protect both parties and be the primary coverage for any and all losses covered by the below described insurance.

2. The OWNER shall be named as additional insured as regards to negligence by the CONTRACTOR [ISO Forms CG 20 10 (Form B) or latest applicable ISO form], or equivalent.

3. The insurance companies issuing the policy or policies shall have no recourse against the OWNER for payment of any premiums or for assessments under any form of policy.

4. Any and all deductibles in the insurance policies shall be assumed by and be for the amount of $10,000.00 and at the sole risk of the CONTRACTOR/Sub-contractor.

5. Any and all communications regarding the insurance shall include the Project name, Project number, proposal number, and OWNER’s address, as identified in the Agreement.

5.05 OWNER’s Liability Insurance

A. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.04, OWNER, at OWNER’s option, may purchase and maintain at OWNER’s expense OWNER’s own liability insurance as shall protect OWNER against claims which may arise from operations under the Contract Documents.

5.06 Property Insurance

A. OWNER shall not be responsible for purchasing and maintaining any property insurance specified in this paragraph 5.06 to protect the interests of CONTRACTOR, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified herein or in the Supplementary Conditions. The risk of loss within such identified deductible amount shall be borne by CONTRACTOR, Subcontractors, or others suffering any such loss, and if any of them wishes
property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser’s own expense.

5.07 Waiver of Rights

5.08 Receipt and Application of Insurance Proceeds

A. Any insured loss under the policies of insurance required shall be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.08.B. OWNER shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

B. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to OWNER’s exercise of this power.

5.09 Acceptance of Bonds and Insurance; Option to Replace

A. If OWNER has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by CONTRACTOR in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the OWNER shall so notify the CONTRACTOR in writing within thirty days after receipt of the certificates (or other evidence requested) required by paragraph 2.05.C. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If CONTRACTOR does not purchase or maintain all of the Bonds and insurance required by the Contract Documents, the OWNER shall notify the CONTRACTOR in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, including, without limitation, termination for default in light of the material importance of the Bonds to OWNER, the OWNER may elect to obtain equivalent Bonds or insurance to protect the OWNER's interests at the expense of the CONTRACTOR who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 Partial Utilization, Acknowledgment of Property Insurer

A. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.
ARTICLE 6 - CONTRACTOR’S RESPONSIBILITIES

6.01 Supervision and Superintendence

A. CONTRACTOR shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of OWNER or ENGINEER in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

B. At all times during the progress of the Work, CONTRACTOR shall assign a competent resident superintendent thereto who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent shall be CONTRACTOR’s representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to or received from the superintendent shall be binding on CONTRACTOR.

For purposes of giving or receiving notice, directives, Change Orders, or any other information from ENGINEER or OWNER to CONTRACTOR, the CONTRACTOR shall designate one person as Project Manager to receive such notice directives, Change Orders, or other information. If the person so identified by CONTRACTOR is not present on the job Site during normal working hours for any consecutive 48 hour period, the CONTRACTOR shall in writing, addressed to ENGINEER and OWNER identify the individual who is acting as Project Manager. CONTRACTOR may designate the resident superintendent as the Project Manager.

6.02 Labor; Working Hours

A. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out, and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, and CONTRACTOR shall not permit overtime work or the performance of Work on Saturday, Sunday, or any legal holiday without OWNER’s written consent (which shall not be unreasonably withheld) given after prior written notice to ENGINEER. For purposes of the foregoing sentence and this Contract "regular working hours" shall mean between 7:00 a.m. and 6:00 p.m. Emergency work may be performed without prior permission. CONTRACTOR shall establish a normal work schedule which does not exceed 40 hours per week. Whenever CONTRACTOR's work requires scheduled overtime, CONTRACTOR shall reimburse OWNER for the extra costs incurred for providing Resident Project Representative services (in accordance with the terms of the Engineer's agreement with the OWNER) which shall be
assessed against CONTRACTOR's progress payments. Overtime shall be scheduled only after CONTRACTOR obtains written permission from OWNER.

6.03 Services, Materials, and Equipment

A. Unless otherwise specified in the General Requirements, CONTRACTOR shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work. All construction equipment and machinery used by CONTRACTOR to perform its obligations under the CONTRACT shall be operational and maintained in good repair during the Contract as necessary for the CONTRACTOR's timely performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents. The CONTRACTOR agrees to assign to the OWNER at the time of final completion of the Work any and all manufacturer's warranties relating to equipment, machinery, materials and labor used and incorporated in the Work and CONTRACTOR further agrees to perform the Work in such a manner to preserve any and all manufacturer's warranties.

6.04 Progress Schedule

A. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.07 as it may be adjusted from time to time as provided below.

1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.07) proposed adjustments in the progress schedule that shall not result in changing the Contract Times (or Milestones). Such adjustments shall conform generally to the progress schedule then in effect and additionally shall comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that shall change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.
6.05 Substitutes and “Or-Equals”

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below.

1. “Or-Equal” Items: If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work shall be required, it may be considered by ENGINEER as an “or-equal” item, in which case review and approval of the proposed item may, in ENGINEER’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.05.A.1, a proposed item of material or equipment shall be considered functionally equal to an item so named if:

   a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it shall reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

   b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it shall conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

   a. If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an “or-equal” item under paragraph 6.05.A.1, it shall be considered a proposed substitute item.

   b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment shall not be accepted by ENGINEER from anyone other than CONTRACTOR.

   c. The procedure for review by ENGINEER shall be as set forth in paragraph 6.05.A.2.d, as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances.

   d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item shall perform adequately
the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application shall state the extent, if any, to which the use of the proposed substitute item shall prejudice CONTRACTOR’s achievement of Substantial Completion on time, whether or not use of the proposed substitute item in the Work shall require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item and whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified shall be identified in the application, and available engineering, sales, maintenance, repair, and replacement services shall be indicated. The application shall also contain an itemized estimate of all costs or credits that shall result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER’s sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER shall be similar to that provided in subparagraph 6.05.A.2.

C. Engineer’s Evaluation: ENGINEER shall be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.05.A and 6.05.B. ENGINEER shall be the sole judge of acceptability. No “or-equal” or substitute shall be ordered, installed or utilized until ENGINEER’s review is complete, which shall be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an “or equal.” ENGINEER shall advise CONTRACTOR in writing of any negative determination.

D. Special Guarantee: OWNER may require CONTRACTOR to furnish at CONTRACTOR’s expense a special performance guarantee or other surety with respect to any substitute.

E. ENGINEER’s Cost Reimbursement: ENGINEER shall record time required by ENGINEER and ENGINEER’s Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.05.A.2 and 6.05.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER’s Consultants for evaluating each such proposed substitute.

F. CONTRACTOR’s Expense: CONTRACTOR shall provide all data in support of any proposed substitute or “or-equal” at CONTRACTOR’s expense.
A. CONTRACTOR shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to OWNER as indicated in paragraph 6.06.B), whether initially or as a replacement, against whom OWNER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection. Notwithstanding the foregoing, CONTRACTOR shall not award any work to any Subcontractor without prior written approval of the OWNER, which approval shall not be given until CONTRACTOR submits the information required regarding Subcontractors in the Bid Instructions or Supplementary Conditions.

If such consent is given, the CONTRACTOR shall be permitted to sublet a portion of the work, but shall perform with his own organization work amounting to at least 50 percent of the total contract cost. Any items designated in the Contract as "specialty items" may be performed by subcontract and the costs of such may be deducted from the total cost before computing the amount of work required to be performed by the CONTRACTOR with his own organization.

Except as provided by law, this provision requiring at least 50 percent of the Work or services to be performed by the Contractor may be waived in whole or in part on Building Construction contracts by resolution, and the Chairman of the Council is authorized to use his discretion in regard to waiving this requirement. Additionally, except as otherwise provided by law, the Parish Attorney’s Office is authorized to omit from Building Construction contracts in whole or in part the provision requiring at least 50 percent of the Work or services to be performed by the Contractor. Determination to waive requirement in whole or in part that at least 50 percent of the Work or services to be performed by the Contractor must be set forth in the bid specifications or addenda.

An approved Subcontractor shall not subcontract any portion of the authorized work. However, except as provided by law, this provision may be waived in whole or in part by resolution, and the Chairman of the Council is authorized to use his discretion in regard to waiving this requirement.

If the CONTRACTOR shall sublet any part of this Contract, the CONTRACTOR shall be as fully responsible to the OWNER for the acts and omissions of his Subcontractor and of any persons either directly or indirectly employed by his Subcontractor as he is for the acts and omissions of persons directly employed by himself.

B. If the Supplementary Conditions or the Bid Instructions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to OWNER in advance for acceptance by OWNER by a specified date prior to the Effective Date of the Agreement, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, or the Bid Instructions, OWNER’s written acceptance of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. CONTRACTOR shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price shall be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order shall be issued or Written Amendment signed. No acceptance by OWNER of any such Subcontractor,
Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

C. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as CONTRACTOR is responsible for CONTRACTOR’s own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other individual or entity, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR.

E. CONTRACTOR shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with ENGINEER through CONTRACTOR.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for CONTRACTOR by a Subcontractor or Supplier shall be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER.

6.07 Patent Fees and Royalties

A. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER’s Consultants, and the officers, directors, partners, employees or agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the
performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 Permits

A. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto, such as plant investment fees.

6.09 Laws and Regulations

A. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR’s compliance with any Laws or Regulations.

B. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work; however, it shall not be CONTRACTOR’s primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR’s obligations under paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids having an effect on the cost or time of performance of the Work may be the subject of an adjustment in Contract Price or Contract Times. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in paragraph 10.05.

D. Pursuant to LSA-R.S. 38:2196, with respect to public contracts involving the state or a political subdivision of the state, when the Work is to be done in this state (Louisiana), or the services are to be provided or the materials are to be supplied in this state, provisions in such agreements requiring disputes arising thereunder to be resolved in a forum outside of this state or requiring their interpretation to be governed by the laws of another jurisdiction are inequitable and against the public policy of this state.

6.10 Taxes

A. CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.
6.11 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas

1. CONTRACTOR shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER’s Consultant, and the officers, directors, partners, employees, agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER, or any other party indemnified hereunder.

B. Removal of Debris During Performance of the Work: During the progress of the Work CONTRACTOR shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. Cleaning: Prior to Substantial Completion of the Work CONTRACTOR shall clean the Site and make it ready for utilization by OWNER. At the completion of the Work CONTRACTOR shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. Loading Structures: CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that shall endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that shall endanger it.

6.12 Record Documents

A. CONTRACTOR shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings shall be available to ENGINEER for reference. Upon
completion of the Work, these record documents, Samples, and Shop Drawings shall be delivered to ENGINEER for OWNER.

6.13 Safety and Protection

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury, or loss to any property referred to in paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER’s Consultant, or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them). CONTRACTOR’s duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 Safety Representative

A. CONTRACTOR shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 Hazard Communication Programs
A. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, CONTRACTOR is obligated to act to prevent threatened damage, injury, or loss. CONTRACTOR shall give ENGINEER notice immediately but in no event more than 24 hours after the alleged emergency if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order shall be issued.

6.17 Shop Drawings and Samples

A. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. All submittals shall be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show ENGINEER the services, materials, and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.17.E.

B. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. Each Sample shall be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.17.E. The numbers of each Sample to be submitted shall be as specified in the Specifications.

C. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER as required by paragraph 2.07, any related Work performed prior to ENGINEER’s review and approval of the pertinent submittal shall be at the sole expense and responsibility of CONTRACTOR.

D. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

   a. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
b. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto; and

d. CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR’s obligations under the Contract Documents with respect to CONTRACTOR’s review and approval of that submittal.

3. At the time of each submittal, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

E. ENGINEER’s Review

1. ENGINEER shall timely review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER. ENGINEER’s review and approval shall be only to determine if the items covered by the submittals shall, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. ENGINEER’s review and approval shall not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such shall not indicate approval of the assembly in which the item functions.

3. ENGINEER’s review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER’s attention to each such variation at the time of each submittal as required by paragraph 6.17.D.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor shall any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.17.D.1.
F. Resubmittal Procedures

1. CONTRACTOR shall make corrections required by ENGINEER and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.18 Continuing the Work

A. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.04 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.19 CONTRACTOR’s General Warranty and Guarantee

A. CONTRACTOR warrants and guarantees to OWNER, ENGINEER, and ENGINEER’s Consultants that all Work shall be in accordance with the Contract Documents and shall not be defective. CONTRACTOR’s warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors, Suppliers, or any other individual or entity for whom CONTRACTOR is responsible; or

2. normal wear and tear under normal usage.

B. CONTRACTOR’s obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following shall constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR’s obligation to perform the Work in accordance with the Contract Documents:

1. observations by ENGINEER;

2. recommendation by ENGINEER or payment by OWNER of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by ENGINEER or any payment related thereto by OWNER;

4. use or occupancy of the Work or any part thereof by OWNER;

5. any acceptance by OWNER or any failure to do so;

6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER;
7. any inspection, test, or approval by others; or
8. any correction of defective Work by OWNER.

6.20 Indemnification

To the fullest extent permitted by law, CONTRACTOR agrees to protect, defend, indemnify and save the OWNER, ENGINEER, ENGINEER Consultants, its agents, officials, employees, servants, including volunteers, or any firm, company, organization, or individual, or their contractors, or subcontractors with whom the OWNER may be contracted, harmless from and against any and all claims, demands, loss or destruction of property, actions, and causes of action of every kind and character including but not limited to claims based on negligence, strict liability, and absolute liability which may arise in favor of any person or persons on account of illness, disease, loss of property, services, wages, death or personal injuries resulting from operations contemplated by this Contract, regardless of whether others may be wholly, concurrently, partially or solely negligent, or strictly liable, or absolutely liable or otherwise at fault, and regardless of any defect in the premises, equipment, or materials, irrespective of whether same preexisted this Agreement, except damages arising out of injuries to or property claims of third parties caused by the sole negligence of OWNER, its employees or agents. Further, CONTRACTOR hereby agrees to indemnify the OWNER for all reasonable expenses including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs incurred by or imposed upon the OWNER in connection therewith for any such loss, damage, injury or other casualty. CONTRACTOR further agrees to pay all reasonable expenses and attorneys' fees incurred by the OWNER in establishing the right to indemnity pursuant to the provisions in this section."

For contracts for purchase and installation and/or maintenance of equipment, or purchase of materials, supplies, or services, the following provision shall apply:

To the fullest extent permitted by law, CONTRACTOR agrees to protect, defend indemnify and save the OWNER its agents, officials, employees, volunteers or any firm, company, organization, or individual, or their contractors, or subcontractors with whom the OWNER may be contracted to, harmless from and against any and all claims, demands, actions and causes of action of every kind and character including but not limited to claims based on negligence, strict liability, and absolute liability which may arise in favor of any person or persons on account of illness, disease, loss of property, services, wages, death or personal injuries resulting from acts or omissions of CONTRACTOR, its agents, employees, assigns, or subcontractors during the operations contemplated by this Contract.

This indemnity does not extend to the sole negligence of the OWNER and the CONTRACTOR shall not be liable to the OWNER for its lost profits or revenue or consequential damages except claims advanced in tort and/or claims advanced in contract due to the bad faith of CONTRACTOR. Bad faith shall mean a breach of some motive or interest of ill shall on the part of the CONTRACTOR.

Further, CONTRACTOR hereby agrees to indemnify the OWNER for all reasonable expenses and fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs incurred by or imposed upon the OWNER in connection therewith for any
such loss, damage, injury or other casualty. CONTRACTOR further agrees to pay all reasonable expenses and attorneys' fees incurred by the OWNER in establishing the right to indemnity pursuant to the provisions in this agreement.

B. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier, or other individual or entity under workers’ compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of CONTRACTOR under paragraph 6.20.A shall not extend to the liability of ENGINEER and ENGINEER’s Consultants or to the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

ARTICLE 7 - OTHER WORK

7.01 Related Work at Site

A. OWNER may perform other work related to the Project at the Site by OWNER’s employees, or let other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof shall be given to CONTRACTOR prior to starting any such other work; and

2. if OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that shall be allowed as a result of such other work, a Claim may be made therefor as provided in paragraph 10.05.

B. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the other work with OWNER’s employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such
other work. CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and shall only cut or alter their work with the written consent of ENGINEER and the others whose work shall be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

C. If the proper execution or results of any part of CONTRACTOR’s Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR’s Work. CONTRACTOR’s failure to so report shall constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR’s Work except for latent defects and deficiencies in such other work.

7.02 Coordination

A. If OWNER intends to contract with others for the performance of other work on the Project at the Site, the following shall be set forth in Supplementary Conditions:

1. the individual or entity who shall have authority and responsibility for coordination of the activities among the various contractors shall be identified;

2. the specific matters to be covered by such authority and responsibility shall be itemized; and

3. the extent of such authority and responsibilities shall be provided.

B. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility for such coordination.

ARTICLE 8 - OWNER’S RESPONSIBILITIES

8.01 Communications to Contractor

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.02 Replacement of ENGINEER

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer whose status under the Contract Documents shall be that of the former ENGINEER.

8.03 Furnish Data

A. OWNER shall promptly furnish the data required of OWNER under the Contract Documents.
8.04  **Pay Promptly When Due**

A. OWNER shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.02.C and 14.07.C.

8.05  **Lands and Easements; Reports and Tests**

A. OWNER’s duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER’s identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by ENGINEER in preparing the Contract Documents.

8.06  **Insurance**

8.07  **Change Orders**

A. OWNER is obligated to execute Change Orders as indicated in paragraph 10.03.

8.08  **Inspections, Tests, and Approvals**

A. OWNER’s responsibility in respect to certain inspections, tests, and approvals is set forth in paragraph 13.03.B.

8.09  **Limitations on OWNER’s Responsibilities**

A. The OWNER shall not supervise, direct, or have control or authority over, nor be responsible for, CONTRACTOR’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. OWNER shall not be responsible for CONTRACTOR’s failure to perform the Work in accordance with the Contract Documents.

8.10  **Undisclosed Hazardous Environmental Condition**

A. OWNER’s responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in paragraph 4.06.

8.11  **Evidence of Financial Arrangements**
ARTICLE 9 - ENGINEER’S STATUS DURING CONSTRUCTION

9.01 OWNER’S Representative

A. ENGINEER shall be OWNER’s representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER’s representative during construction are set forth in the Contract Documents and shall not be changed without written consent of OWNER and ENGINEER.

B. The ENGINEER shall identify a specific individual to serve as liaison between the OWNER and CONTRACTOR and between the ENGINEER and CONTRACTOR. The ENGINEER shall notify the OWNER and CONTRACTOR of the name of an acting replacement as ENGINEER representative whenever the person so designated is not available. Whenever the CONTRACTOR or OWNER requires information, direction, or assistance, the CONTRACTOR or OWNER shall notify the individual designated by the ENGINEER.

9.02 Visits to Site

A. ENGINEER shall make visits to the Site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR’s executed Work. Based on information obtained during such visits and observations, ENGINEER, for the benefit of OWNER, shall determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER shall not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. ENGINEER’s efforts shall be directed toward providing for OWNER a greater degree of confidence that the completed Work shall conform generally to the Contract Documents. On the basis of such visits and observations, ENGINEER shall keep OWNER informed of the progress of the Work and shall endeavor to guard OWNER against defective Work.

B. ENGINEER’s visits and observations are subject to all the limitations on ENGINEER’s authority and responsibility set forth in paragraph 9.10, and particularly, but without limitation, during or as a result of ENGINEER’s visits or observations of CONTRACTOR’s Work ENGINEER shall not supervise, direct, control, or have authority over or be responsible for CONTRACTOR’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

9.03 Project Representative

A. If OWNER and ENGINEER agree, ENGINEER shall furnish a Resident Project Representative to assist ENGINEER in providing more extensive observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants shall be as provided in paragraph 9.10 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the Site who is not
ENGINEER’s Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity shall be as provided in the Supplementary Conditions.

9.04 Clarifications and Interpretations

A. ENGINEER shall issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations shall be binding on OWNER and CONTRACTOR. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a written clarification or interpretation, a Claim may be made therefor as provided in paragraph 10.05.

9.05 Authorized Variations in Work

A. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and shall be binding on OWNER and also on CONTRACTOR, who shall perform the Work involved promptly. ENGINEER shall promptly obtain the signature of the CONTRACTOR on all Field Orders. This signature confirms the CONTRACTOR's acknowledgment that the CONTRACTOR is not entitled to any change in the Contract Price or the Contract Times. The ENGINEER shall obtain the signature of the CONTRACTOR on all Field Orders on a weekly basis.

9.06 Rejecting Defective Work

A. ENGINEER shall have authority to disapprove or reject Work which ENGINEER believes to be defective, or that ENGINEER believes shall not produce a completed Project that conforms to the Contract Documents or that shall prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER shall also have authority to require special inspection or testing of the Work as provided in paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.07 Shop Drawings, Change Orders and Payments

A. In connection with ENGINEER’s authority as to Shop Drawings and Samples, see paragraph 6.17.

B. In connection with ENGINEER’s authority as to Change Orders, see Articles 10, 11, and 12.

C. In connection with ENGINEER’s authority as to Applications for Payment, see Article 14.
9.08 **Determinations for Unit Price Work**

A. ENGINEER shall determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER shall review with CONTRACTOR the ENGINEER’s preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER’s written decision thereon shall be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.05.

9.09 **Decisions on Requirements of Contract Documents and Acceptability of Work**

A. ENGINEER shall be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work, the quantities and classifications of Unit Price Work, the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, and Claims seeking changes in the Contract Price or Contract Times shall be referred initially to ENGINEER in writing, in accordance with the provisions of paragraph 10.05, with a request for a formal decision.

B. When functioning as interpreter and judge under this paragraph 9.09, ENGINEER shall not show partiality to OWNER or CONTRACTOR and shall not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to this paragraph 9.09 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.07) shall be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

9.10 **Limitations on ENGINEER’s Authority and Responsibilities**

A. Neither ENGINEER’s authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by ENGINEER shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. ENGINEER shall not supervise, direct, control, or have authority over or be responsible for CONTRACTOR’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. ENGINEER shall not be responsible for CONTRACTOR’s failure to perform the Work in accordance with the Contract Documents.

C. ENGINEER shall not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
D. ENGINEER’s review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by paragraph 14.07.A shall only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this paragraph 9.10 shall also apply to ENGINEER’s Consultants, Resident Project Representative, and assistants.

F. The duties, responsibilities, and limitations of authority of the Resident Project Representative are as further defined in the Supplementary Conditions and Exhibit A, which is attached thereto and incorporated therein by reference.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 Authorized Changes in the Work

A. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which shall be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided). A change in the Contract Price or the Contract Times shall be accomplished only by a Written Amendment, a Change Order, or a Work Change Directive. Accordingly, no course of conduct or dealings between the parties, no express or implied acceptance of alterations or additions to the Work, and no claim that the OWNER has been unjustly enriched by any alterations or additions to the Work shall be the basis of any claim for an increase in any amount due under the Contract Documents or a change in any time period provided for in the Contract Documents.

B. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in paragraph 10.05.

10.02 Unauthorized Changes in the Work

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in paragraph 3.04, except in the case of an emergency as provided in paragraph 6.16 or in the case of uncovering Work as provided in paragraph 13.04.B.
10.03 Execution of Change Orders

A. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

1. changes in the Work which are: (i) ordered by OWNER pursuant to paragraph 10.01.A, (ii) required because of acceptance of defective Work under paragraph 13.08.A or OWNER’s correction of defective Work under paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.18.A. Agreements on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Price and the Contract Times. In the event a Change Order increases the Contract Price, the CONTRACTOR shall include the Work covered by such Change Order in applications for payments as if such Work were originally part of the Contract Documents.

10.04 Notification to Surety

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice shall be CONTRACTOR’s responsibility. The amount of each applicable Bond shall be adjusted to reflect the effect of any such change.

10.05 Claims and Disputes

A. Notice: Written notice stating the general nature of each Claim, dispute, or other matter shall be delivered by the claimant to ENGINEER and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. Notice of the amount or extent of the Claim, dispute, or other matter with supporting data shall be delivered to the ENGINEER and the other party to the Contract within 60 days after the start of such event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of such Claim, dispute, or other matter). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of paragraph 12.02.B. Each Claim shall be accompanied by claimant’s written statement that the adjustment claimed is the entire adjustment to
which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to ENGINEER and the claimant within 30 days after receipt of the claimant’s last submittal (unless ENGINEER allows additional time).

B. **ENGINEER’s Decision:** ENGINEER shall render a formal decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any. ENGINEER’s written decision on such Claim, dispute, or other matter shall be final and binding upon OWNER and CONTRACTOR unless:

1. an appeal from ENGINEER’s decision is taken within the time limits and in accordance with the dispute resolution procedures set forth in Article 16; or
2. if no such dispute resolution procedures have been set forth in Article 16, a written notice of intention to appeal from ENGINEER’s written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within 30 days after the date of such decision, and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction within 60 days after the date of such decision or within 60 days after Substantial Completion, whichever is later (unless otherwise agreed in writing by OWNER and CONTRACTOR), to exercise such rights or remedies as the appealing party may have with respect to such Claim, dispute, or other matter in accordance with applicable Laws and Regulations.

C. If ENGINEER does not render a formal decision in writing within the time stated in paragraph 10.05.B, a decision denying the Claim in its entirety shall be deemed to have been issued 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. No Claim for an adjustment in Contract Price or Contract Times (or Milestones) shall be valid if not submitted in accordance with this paragraph 10.05.

**ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK**

11.01 **Cost of the Work**

A. **Costs Included:** The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to CONTRACTOR shall be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in paragraph 11.01.B.

1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed
full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers’ compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER in writing.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers’ field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER, who shall then determine, with the advice of ENGINEER, which bids, if any, shall be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor’s Cost of the Work and fee shall be determined in the same manner as CONTRACTOR’s Cost of the Work and fee as provided in this paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work, but only to the extent authorized and approved in writing by ENGINEER.

5. Supplemental costs including the following:

   a. The proportion of necessary transportation, travel, and subsistence expenses of CONTRACTOR’s employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

   c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
d. Sales, consumer, use, and other similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work, provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR’s fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.

i. When the Cost of the Work is used to determine the value of a Change Order or of a Claim, the cost of premiums for additional Bonds and insurance required because of the changes in the Work or caused by the event giving rise to the Claim.

B. Costs Excluded: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of CONTRACTOR’s officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR’s principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.01.A.1 or specifically covered by paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the CONTRACTOR’s fee.

2. Expenses of CONTRACTOR’s principal and branch offices other than CONTRACTOR’s office at the Site.

3. Any part of CONTRACTOR’s capital expenses, including interest on CONTRACTOR’s capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraphs 11.01.A and 11.01.B.

C. CONTRACTOR’s Fee: When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR’s fee shall be determined as set forth in paragraph 12.01.C.

D. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to paragraphs 11.01.A and 11.01.B, CONTRACTOR shall establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

11.02 Cash Allowances

A. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

1. the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. CONTRACTOR’s costs for unloading and handling on the Site, labor, installation costs, overhead, profit, and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing shall be valid.

B. Prior to final payment, an appropriate Change Order shall be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price shall be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR shall be made by ENGINEER subject to the provisions of paragraph 9.08.

B. Each unit price shall be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR’s overhead and profit for each separately identified item.
The unit price of an item of Unit Price Work shall be subject to reevaluation and adjustment under the following conditions:

(1) if the total cost of a particular item of Unit Price Work amounts to ten (10) percent or more of the Contract Price and the variation in the quantity twenty-five (25) percent from the estimated quantity of such item indicated in the Agreement; and

(2) if there is no corresponding adjustment with respect to any other item of Work; and

(3) if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof; or if OWNER believes that the quantity variation entitles OWNER to an adjustment in the unit price, either OWNER or CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with paragraph 10.05 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 Change of Contract Price

A. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price shall be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 12.01.C.2); or

C. CONTRACTOR’s Fee: The CONTRACTOR’s fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee

12.02 Change of Contract Times

A. The Contract Times (or Milestones) may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Times (or Milestones) shall be based on
written notice submitted by the party making the claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. Any adjustment of the Contract Times (or Milestones) covered by a Change Order or of any Claim for an adjustment in the Contract Times (or Milestones) shall be determined in accordance with the provisions of this Article 12. No claims for an adjustment in the Contract Times (or Milestones) shall be valid unless submitted and determined in accordance with the provisions of this Article 12.

C. All time limits stated in the Contract Documents are of the essence of the Agreement. The CONTRACTOR acknowledges and understands that failure by the CONTRACTOR shall cause significant damage to the OWNER both in direct damages as well as delay damages, including but not limited to the damages specified in the Agreement as actual damages and as liquidated damages.

12.03 Delays Beyond CONTRACTOR’s Control

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) shall be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in paragraph 12.02.A. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

12.04 Delays Within CONTRACTOR’s Control

A. The Contract Times (or Milestones) shall not be extended due to delays within the control of CONTRACTOR. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.05 Delays Beyond OWNER’s and CONTRACTOR’s Control

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or ARTICLE Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR’s sole and exclusive remedy for such delay.

12.06 Delay Damages

A. Apart from extension of time for unavoidable delays and the waiving of any applicable liquidated damages, in no event shall OWNER or ENGINEER be liable to the CONTRACTOR, any Subcontractor, and Supplier, or any other person or organization, or any surety for or any employee or agent of any of them, and no payment or allowance of any kind shall be made to the CONTRACTOR as compensation for damages because of hindrance or delay for any cause in the progress of Work, whether such delay be avoidable or unavoidable. Time limitations required by OWNER shall be for the benefit of OWNER and contractors under other contracts who have entered
ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

A. Prompt notice of all defective Work of which OWNER or ENGINEER has actual knowledge shall be given to CONTRACTOR. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

A. OWNER, ENGINEER, ENGINEER’s Consultants, other representatives and personnel of OWNER, independent testing laboratories, and governmental agencies with jurisdictional interests shall have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR’s Site safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

A. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.04.B shall be paid as provided in said paragraph 13.04.B; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection or approval.
D. CONTRACTOR shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for OWNER’s and ENGINEER’s acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR’s purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to OWNER and ENGINEER.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

F. Uncovering Work as provided in paragraph 13.03.E shall be at CONTRACTOR’s expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR’s intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.04 Uncovering Work

A. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER’s observation and replaced at CONTRACTOR’s expense.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER’s request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. If it is found that such Work is defective, CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction, unless CONTRACTOR fails to provide written notice as required by paragraph 13.03.F. If the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

13.05 OWNER May Stop the Work

A. If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work shall conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this
right for the benefit of CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 Correction or Removal of Defective Work

A. CONTRACTOR shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by ENGINEER, remove it from the Project and replace it with Work that is not defective. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.07 Correction Period

A. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for CONTRACTOR’s use by OWNER or permitted by Laws and Regulations as contemplated in paragraph 6.11.A is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER’s written instructions: (i) repair such defective land or areas, or (ii) correct such defective Work or, if the defective Work has been rejected by OWNER, remove it from the Project and replace it with Work that is not defective, and (iii) satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or repaired or may have the rejected Work removed and replaced, and all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) shall be paid by CONTRACTOR.

B. In special circumstances where a particular item of equipment is placed in continuous service for the benefit of OWNER before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

C. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph 13.07, the correction period hereunder with respect to such Work shall be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
D. CONTRACTOR’s obligations under this paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER’s recommendation of final payment, ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to OWNER’s evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by CONTRACTOR pursuant to this sentence. If any such acceptance occurs prior to ENGINEER’s recommendation of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and OWNER shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount shall be paid by CONTRACTOR to OWNER.

13.09 OWNER May Correct Defective Work

A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06.A, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days written notice to CONTRACTOR, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph, OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work and suspend CONTRACTOR’s services related thereto, take possession of CONTRACTOR’s tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER’s representatives, agents and employees, OWNER’s other contractors, and ENGINEER and ENGINEER’s Consultants access to the Site to enable OWNER to exercise the rights and remedies under this paragraph.

C. All Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by OWNER in exercising the rights and remedies under this paragraph 13.09 shall be charged against CONTRACTOR, and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to
agree as to the amount of the adjustment, OWNER may make a Claim therefor as provided in paragraph 10.05. Such claims, costs, losses and damages shall include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of CONTRACTOR’s defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER’s rights and remedies under this paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

A. The schedule of values established as provided in paragraph 2.07.A shall serve as the basis for progress payments and shall be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work shall be based on the number of units completed.

14.02 Progress Payments

A. Applications for Payments

1. At least 20 days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect OWNER’s interest therein, all of which must be satisfactory to OWNER.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of CONTRACTOR stating that all previous progress payments received on account of the Work have been applied on account to discharge CONTRACTOR’s legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments shall be as stipulated in the Agreement.

4. CONTRACTOR shall also comply with the following specific requirements:
a. The aggregate cost of materials stored offsite shall not at any time, without written approval of the OWNER, exceed the amount identified in the Supplementary Conditions.

b. Title to such materials shall be vested in the OWNER, as evidenced by documentation satisfactory in form and substance to the OWNER, including, without limitation, recorded financing statements, UCC filings, and UCC searches.

c. With each application for payment, the CONTRACTOR shall submit to the OWNER a written list identifying each location where materials are stored off the Project Site and the value of materials at each location. The CONTRACTOR shall procure insurance satisfactory to the OWNER for materials stored off the Project Site in an amount not less than the total value thereof.

d. The consent of any Surety shall be obtained to the extent required prior to payment for any materials stored off the Project Site.

e. Representatives of the OWNER shall have the right to make inspections of the storage areas at any time.

f. Such materials shall be (1) protected from diversion, destruction, theft and damage to the satisfaction of the OWNER; (2) specifically marked for use on the Project; and (3) segregated from other materials at the storage facility.

B. Review of Applications

1. ENGINEER shall, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER or return the Application to CONTRACTOR indicating in writing ENGINEER’s reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.

2. ENGINEER’s recommendation of any payment requested in an Application for Payment shall constitute a representation by ENGINEER to OWNER, based on ENGINEER’s observations on the Site of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER’s knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.08, and to any other qualifications stated in the recommendation); and
c. the conditions precedent to CONTRACTOR’s being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER’s responsibility to observe the Work.

3. By recommending any such payment ENGINEER shall not thereby be deemed to have represented that: (i) inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents; or (ii) that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

4. Neither ENGINEER’s review of CONTRACTOR’s Work for the purposes of recommending payments nor ENGINEER’s recommendation of any payment, including final payment, shall impose responsibility on ENGINEER to supervise, direct, or control the Work or for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for CONTRACTOR’s failure to comply with Laws and Regulations applicable to CONTRACTOR’s performance of the Work. Additionally, said review or recommendation shall not impose responsibility on ENGINEER to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price, or to determine that title to any of the Work, materials, or equipment has passed to OWNER free and clear of any Liens.

5. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER’s opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.02.B.2. ENGINEER may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in ENGINEER’s opinion to protect OWNER from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Written Amendment or Change Orders;

c. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.09; or

d. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.A.

e. ENGINEER has knowledge that CONTRACTOR has failed to pay Subcontractors or Suppliers or for labor;

f. CONTRACTOR has failed to make submittals in accordance with the accepted schedules or otherwise failed to comply with paragraph 2.07;
g. CONTRACTOR owes or may owe OWNER liquidated damages, actual damages, or both, in accordance with the provisions in the Agreement regarding delay in completion of the Work within the Contract Times.

C. Payment Becomes Due

1. Thirty days after presentation of the Application for Payment to OWNER with ENGINEER’s recommendation, the amount recommended shall (subject to the provisions of paragraph 14.02.D) become due, and when due shall be paid by OWNER to CONTRACTOR.

D. Reduction in Payment

1. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

   a. claims have been made against OWNER on account of CONTRACTOR’s performance or furnishing of the Work;

   b. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;

   c. there are other items entitling OWNER to a set-off against the amount recommended; or

   d. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.02.B.5.a through 14.02.B.5.c and 14.02.B.5.e through 14.02.B.5.g. or paragraph 15.02.A.

2. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER’s satisfaction the reasons for such action.

3. If it is subsequently determined that OWNER’s refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.02.C.1.

14.03 CONTRACTOR’s Warranty of Title

A. CONTRACTOR warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, shall pass to OWNER no later than the time of payment free and clear of all Liens.
14.04 Substantial Completion

A. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Promptly thereafter, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER shall notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER shall prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER shall within 14 days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER’s objections, ENGINEER considers the Work substantially complete, ENGINEER shall within said 14 days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER shall deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER’s issuing the definitive certificate of Substantial Completion, ENGINEER’s aforesaid recommendation shall be binding on OWNER and CONTRACTOR until final payment.

B. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

14.05 Partial Utilization

A. Use by OWNER at OWNER’s option of any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which OWNER, ENGINEER, and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR’s performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following conditions.

1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially
complete, CONTRACTOR shall certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER shall notify OWNER and CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraph 14.04 shall apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

2. No occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of paragraph 5.10 regarding property insurance.

3. OWNER may at any time request CONTRACTOR in writing to permit OWNER to take over operation of any such part of the Work although it is not substantially complete. A copy of such request shall be sent to ENGINEER and within a reasonable time thereafter OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion and shall prepare a list of the items remaining to be completed or corrected thereon before final payment. If CONTRACTOR does not object in writing to OWNER and ENGINEER that such part of the Work is not ready for separate operation by OWNER, ENGINEER shall finalize the list of items to be completed or corrected and shall deliver such lists to OWNER and CONTRACTOR together with a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work which shall become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing and so informed ENGINEER). During such operation and prior to Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on said list and to complete other related Work.

14.06 Final Inspection

A. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER shall promptly make a final inspection with OWNER and CONTRACTOR and shall notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 Final Payment

A. Application for Payment
1. After CONTRACTOR has, in the opinion of ENGINEER, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in paragraph 6.12), and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.04.B.7; (ii) consent of the surety, if any, to final payment.

B. Review of Application and Acceptance

1. If, on the basis of ENGINEER’s observation of the Work during construction and final inspection, and ENGINEER’s review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR’s other obligations under the Contract Documents have been fulfilled, ENGINEER shall, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER’s recommendation of payment and present the Application for Payment to OWNER for payment. At the same time ENGINEER shall also give written notice to OWNER and CONTRACTOR. If, on the basis of ENGINEER’S observation of the Work during construction and final inspection, and ENGINEER’S review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR’S other obligations under the Contract Documents have been fulfilled, ENGINEER shall, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER’S recommendation of payment and present the Application for Payment to OWNER for payment. At the same time ENGINEER shall also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.09. Otherwise, ENGINEER shall return the Application for Payment to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. After the presentation to OWNER of the Application for Payment and accompanying documentation, the amount recommended by ENGINEER shall become due and, when due, shall be paid by OWNER to CONTRACTOR in accordance with the Louisiana Public Contract Statute.

2. Following acceptance of the Work by OWNER, CONTRACTOR shall file the acceptance with the Clerk of Court and Ex-Officio Recorder of Mortgages.

3. Release and payment of Retainage, or balance due, shall become due and shall be paid by OWNER to CONTRACTOR thirty days after receipt of Application for Retainage Payment.
(which must include a clear lien and privilege certificate secured from the Clerk of Court and Ex-Officio Recorder of Mortgages dated no less than forty-five (45) days after the filing of the acceptance and other documentation as required by the Contract Documents), and recommendation of payment by ENGINEER.

14.08 Final Completion Delayed

A. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR’s final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims. The completion of the various items may not be a requirement for Substantial Completion.

14.09 Waiver of Claims

A. The making and acceptance of final payment shall constitute:

1. a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR’s continuing obligations under the Contract Documents; and

2. a waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing which are still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 OWNER May Suspend Work

A. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to CONTRACTOR and ENGINEER which shall fix the date on which Work shall be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes a Claim therefor as provided in paragraph 10.05.
15.02 OWNER May Terminate for Cause

A. The occurrence of any one or more of the following events shall justify termination for cause:

1. CONTRACTOR’s persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.07 as adjusted from time to time pursuant to paragraph 6.04);

2. CONTRACTOR’s disregard of Laws or Regulations of any public body having jurisdiction;

3. CONTRACTOR’s disregard of the authority of ENGINEER; or

4. CONTRACTOR’s violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in paragraph 15.02.A occur, OWNER may, after giving CONTRACTOR (and the surety, if any) seven days written notice, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, and take possession of the Work and of all CONTRACTOR’s tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by OWNER arising out of or relating to completing the Work, such excess shall be paid to CONTRACTOR. If such claims, costs, losses, and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, and damages incurred by OWNER shall be reviewed by ENGINEER as to their reasonableness and, when so approved by ENGINEER, incorporated in a Change Order. When exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

C. Where CONTRACTOR’s services have been so terminated by OWNER, the termination shall not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER shall not release CONTRACTOR from liability.
15.03 OWNER May Terminate For Convenience

A. Upon seven days written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Contract. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. for all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. for reasonable expenses directly attributable to termination.

B. CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 CONTRACTOR May Stop Work or Terminate

A. If, through no act or fault of CONTRACTOR, the Work is suspended for more than 90 consecutive days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within 30 days after it is submitted, or OWNER fails for 30 days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Contract and recover from OWNER payment on the same terms as provided in paragraph 15.03. In lieu of terminating the Contract and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within 30 days after it is submitted, or OWNER has failed for 30 days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may, seven days after written notice to OWNER and ENGINEER, stop the Work until payment is made of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.04 are not intended to preclude CONTRACTOR from making a Claim under paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR’s stopping the Work as permitted by this paragraph.

ARTICLE 16 - RESERVED
ARTICLE 17 – MISCELLANEOUS

17.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice, it shall be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 Computation of Times

A. When any period of time is referred to in the Contract Documents by days, it shall be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day shall be omitted from the computation.

17.03 Cumulative Remedies

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto and, in particular but without limitation, the warranties, guarantees, and obligations imposed upon CONTRACTOR hereunder and all of the rights and remedies available to OWNER and ENGINEER thereunder are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents, and the provisions of this paragraph shall be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 Survival of Obligations

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, shall survive final payment, completion, and acceptance of the Work or termination or completion of the Agreement.

B. Nothing herein, in the Agreement, or any of the other Contract Documents shall be construed as a waiver, modification, or alteration of the CONTRACTOR's or its surety's obligations under La. R.S. 38:2189. Nothing in this paragraph or any other provision in the General Conditions or other Contract Documents concerning any specific time periods shall establish a period of limitation with respect to any other obligation which CONTRACTOR has under the Contract Documents. The establishment of time periods relates only to the specific obligations of CONTRACTOR to correct the Work, and has no relationship to the time within which CONTRACTOR's obligations under the Contract Documents may be sought to be enforced, nor to the time within which the proceedings may be commenced to establish CONTRACTOR's liability with respect to CONTRACTOR's obligations other than specifically to correct the Work.
17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.
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PART 1   GENERAL

1.1   GENERAL

Payment items for the work of this contract for which contract lump sum or unit price items payments will be made are listed in the BIDDING SCHEDULE and described below. All costs for items of work, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the work involved. The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

1.1.1   Mobilization and Demobilization

No separate measurement will be made for mobilization and demobilization. Payment will be made at the contract lump sum price for "Mobilization and Demobilization". Price and payment shall constitute full compensation for furnishing all plant, labor, materials, and equipment and all other work incidental thereto.

1.1.2   Construction Progress Documentation

No separate measurement and payment will be made for documentation of all procurement and construction activities. All costs associated therewith shall be included in all the unit prices or lump sum prices contained in the Bidding Schedule and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 01 32 16.00 20 CONSTRUCTION PROGRESS DOCUMENTATION.

1.1.3   Submittal Procedures

No separate measurement or payment will be made for providing submittal requirements. All costs associated therewith shall be included in all the unit prices or lump sum prices contained in the Bidding Schedule and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 01 33 00 SUBMITTAL PROCEDURES.

1.1.4   Quality Control System (QCS)

No separate measurement and payment will be made for providing and maintaining an effective Quality Control System. All costs associated therewith shall be included in all the unit prices or lump sum prices contained in the Bidding Schedule and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 01 45 02.00 10 QUALITY CONTROL SYSTEM (QCS).
1.1.5  Contractor Quality Control

No separate measurement and payment will be made for providing and maintaining an effective Quality Control program. All costs associated therewith shall be included in all the unit prices or lump sum prices contained in the Bidding Schedule and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.1.6  Temporary Retaining Structures

No separate measurement will be made for temporary retaining structures. Payment will be made at the contract lump sum price for "Temporary Retaining Structures". Price and payment shall constitute full compensation for furnishing all plant, labor, materials, and equipment; designing, furnishing, installing, maintaining, and removing the temporary retaining structures and all other work incidental thereto as specified in Section 01 53 00.02 12 TEMPORARY RETAINING STRUCTURES and as shown on the plans.

1.1.7  Traffic Control and Coordination

No separate measurement will be made for the preparation of a traffic control device plan, nor the implementation, maintenance, control and coordination of traffic routing including barricades, warning and detour signs, flagmen and associated work. Payment will be made at the contract lump sum price for "Traffic Control and Coordination". Price and payment shall constitute full compensation for providing all plant, labor, materials and equipment to complete the work as specified in Section 01 55 26.00 12 TRAFFIC CONTROL AND COORDINATION and as shown on the plans.

1.1.8  Environment Protection

No separate measurement or payment will be made for environment protection including protection of fish and wildlife, and disposal of waste. All costs associated therewith shall be included in all the unit prices or lump sum prices contained in the Bidding Schedule and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 01 57 20.00 12 ENVIRONMENT PROTECTION and as shown on the plans.

1.1.9  Silt Fences

Measurement for silt fences will be made by the linear foot. Payment for silt fences will be made at the contract unit price per linear foot for "Silt Fences." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, including geotextile, and performing all operations necessary for the placement, maintenance, removal, and disposal of silt fences throughout the contract period, including final dressing and cleanup as specified in Section 01 57 23.00 12 STORM WATER POLLUTION PREVENTION MEASURES and as shown on the plans.

1.1.10  Turbidity Curtain

Measurement for turbidity curtain will be made by the linear foot. Payment for turbidity curtain as specified will be made at the contract unit price per linear foot for "Turbidity Curtain." Price and payment shall constitute full compensation for furnishing all plant, labor,
materials and equipment, including geotextile, and performing all operations necessary for the placement, maintenance, removal, and disposal of turbidity curtain throughout the contract period, including final dressing and cleanup as specified in Section 01 57 23.00 12 STORM WATER POLLUTION PREVENTION MEASURES and as shown on the plans.

1.1.11 Truck Wash Down Racks

No separate measurement will be made for truck wash down racks. Payment for truck wash down racks will be made at contract lump sum price for "Truck Wash Down Racks". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment as required.

1.1.12 Truck Wash Down Racks

No separate measurement will be made for the temporary truck wash-down rack designed, constructed and maintained by the Contractor. Payment for the temporary truck wash-down rack, including its maintenance and removal, will be made at the contract lump sum price for "Truck Wash Down Racks." Price and payment shall constitute full compensation for furnishing the design, and all plant, labor, equipment, and material to complete the work as specified in Section 01 57 23.01 12 TRUCK WASH DOWN RACKS and as shown on drawings.

1.1.13 Closeout Submittals

No separate measurement and payment will be made for providing Closeout Submittals, including as-built drawings. All costs associated therewith shall be included in all the unit prices or lump sum prices contained in the Bidding Schedule and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 01 78 02.00 10 CLOSEOUT SUBMITTALS.

1.1.14 Demolition

No measurement will be made for demolition. Payment will be made under the contract lump sum price for "Demolition". Price and payment shall constitute full compensation for the work and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 02 41 00 SELECTIVE DEMOLITION and as shown on the plans.

1.1.15 Formwork for Concrete

No separate measurement or payment will be made for formwork for concrete. All costs in connection therewith shall be included in the contract prices for the items to which the work is incidental thereto and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 03 11 14.00 12 FORMWORK FOR CONCRETE.

1.1.16 Expansion Joints and Waterstops in Concrete

No separate measurement or payment will be made for expansion joints and waterstops in concrete. All costs in connection therewith shall be included in the contract prices for the items to which the work is incidental thereto and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified
in Section 03 15 13.00 12 EXPANSION JOINTS AND WATERSTOPS IN CONCRETE.

1.1.17 Reinforcing Steel

No separate measurement or payment will be made for reinforcement bars and accessories in concrete. Payment for furnishing and placing reinforcement bars and accessories shall be included in the contract prices for the items to which work is incidental thereto and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 03 21 00.00 12 REINFORCING STEEL.

1.1.18 Concrete for Minor Structures

No separate measurement will be made for concrete for minor structures. Payment will be made at the contract lump sum price for "Concrete for Minor Structures". Payment shall constitute full compensation for furnishing all plant, labor, materials, equipment and tools including, but not limited to, all formwork, reinforcing steel, expansion joint filler, miscellaneous metal and other components incidental thereto to complete concrete work for manholes, catch basins, slabs, pipe bollards, footings, pipe supports, equipment pads and all ancillary concrete structures as specified in Section 03 30 04.00 12 CONCRETE FOR MINOR STRUCTURES and as shown on the plans.

1.1.19 Cast-In-Place Structural Concrete

No separate measurement will be made for reinforced structural concrete. Payment for reinforced structural concrete will be made at the contract lump sum price for "Structural Concrete". Price and payment shall include the cost of all plant, labor, materials, equipment and tools but not limited to, all formwork, reinforcing steel, expansion joint filler, waterstops, stabilization slabs, miscellaneous metal and other components incidental thereto to complete concrete work for box culverts, U-channels, headworks structure, flood wall, pump station structure, head walls, wing walls, base slabs, and other components incidental thereto as specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE as shown on the plans.

1.1.20 Welding, Structural

No separate measurement or payment will be made for structural welding. All costs in connection therewith shall be included in the contract prices for the items to which the work is incidental thereto and shall include the furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 05 05 23 WELDING, STRUCTURAL.

1.1.21 Ultrasonic Inspection of Weldments

No separate measurement or payment will be made for Ultrasonic Inspection of Weldments. All costs in connection therewith shall be included in the contract prices for the items to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 05 05 23.13 10 ULTRASONIC INSPECTION OF WELDMENTS.

1.1.22 Structural Steel

No separate measurement or payment will be made for Structural Steel. All costs in connection therewith shall be included in the contract prices for
the items to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 05 12 00 STRUCTURAL STEEL.

1.1.23 Steel Joist Girder Framing

No separate measurement or payment will be made for steel joist girder framing. All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to install Steel Joist Girder Framing work as specified in Section 05 21 23 STEEL JOIST GIRDER FRAMING.


No separate measurement and payment will be made for the Metalwork Fabrication, Machine Work, and Miscellaneous Provisions. All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete this work as specified in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

1.1.25 Miscellaneous, Standard Articles, Shop Fabricated Items

No separate measurement will be made for Miscellaneous Metalwork. Payment for miscellaneous metalwork will be made at the contract lump sum price for "Miscellaneous Metalwork". Price and payment shall constitute full compensation for furnishing and installing all miscellaneous metalwork indicated on the drawings and/or specified in Section 05 50 04.01 12 MISCELLANEOUS, STANDARD ARTICLES, SHOP FABRICATED ITEMS which is not specified to be paid for under other items of work listed on the bidding schedule.

1.1.26 Metal Ladders

No separate measurement will be made for Metal Ladders. Payment for Metal Ladders will be made at the contract lump sum price for "Metal Ladders". Price and payment shall constitute full compensation for furnishing of all plant, labor, materials, equipment and tools but not limited to, structural steel tubing, aluminum products, steel hardware, galvanizing, painting and incidentals required to complete the installation of Metal Ladders work as specified in SECTION 05 51 33 METAL LADDERS and as shown on the plans.

1.1.27 Metal Railings

No separate measurement will be made for Metal Railings. Payment for Metal Railings will be made at the contract lump sum price for "Metal Railings". Price and payment shall constitute full compensation for furnishing of all plant, labor, materials, equipment and tools but not limited to, structural steel tubing, aluminum products, steel hardware, galvanizing, welding, painting and incidentals required to complete the installation of Metal Railings work as specified in SECTION 05 52 00 METAL RAILINGS and as shown on the plans.

1.1.28 Firestopping

No separate measurement or payment will be made for Firestopping system.
All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete the installation of Firestopping system work as specified in Section 07 84 00 FIRESTOPPING.

1.1.29 Steel Doors and Frames

No separate measurement will be made for Steel Doors and Frames. Payment for Steel Doors and Frames will be made at the contract lump sum price for "Steel Doors and Frames". Price and payment shall constitute full compensation for furnishing all plant, labor, materials, equipment and tools but not limited to, steel doors, steel hardware, steel frames, insulation cores, welding, stops and beads, anchors, wall anchors, weather stripping, factory applied painting and incidental repairs required to complete this work as specified in SECTION 05 52 00 METAL RAILINGS and as shown on the plans.

1.1.30 Overhead Coiling Doors

No separate measurement will be made for Overhead Coiling Doors. Payment for Steel Doors and Frames will be made at the contract lump sum price for "Overhead Coiling Doors". Price and payment shall constitute full compensation for furnishing all plant, labor, materials, equipment and tools but not limited to, fir rated doors, frames and hardware, curtain bottom bars, locking devices, weather stripping, guides, electric motor operator, painting and incidental repairs required to complete this work as specified in SECTION 08 33 23 OVERHEAD COILING DOORS and as shown on the plans.

1.1.31 Door Hardware

No separate measurement or payment will be made for Door Hardware. All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete the installation of door hardware as specified in Section 08 71 00 DOOR HARDWARE.

1.1.32 Metal Wall and Door Louvers

No separate measurement or payment will be made for Metal Wall and Door Louvers. All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete the installation of Metal Wall and Door Louvers as specified in Section 08 91 00 METAL WALL AND DOOR LOUVERS.

1.1.33 Paints and Coatings

No separate measurement will be made for Paints and Coatings. Payment will be made at the contract lump sum price for "Paints and Coatings", which includes full compensation for furnishing all materials, equipment, and labor required for painting and coating structures as specified in Section 09 90 00 PAINTS AND COATINGS and as shown on the plans.

1.1.34 High Performance Coatings

No separate measurement or payment will be made for High Performance Coatings.
Coatings. All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete the High Performance Coatings to items as specified in Section 09 96 00 HIGH-PERFORMANCE COATINGS.

1.1.35 Painting: Hydraulic Structures

No separate measurement or payment will be made for Painting: Hydraulic Structures. All costs in connection therewith shall be included in the contract prices to which the work is incidental thereto and shall include furnishing of all plant, equipment, labor and materials required to complete the Painting Hydraulic Structures as specified in Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES and as shown on the plans.

1.1.36 Painting: Coal Tar Epoxy System

No separate measurement will be made for painting Coal Tar Epoxy System on Sheet Piling, Steel Discharge Pipes, H-Piles, and Pipe Piles. Payment shall be included in the contract lump sum price for "Painting Coal Tar Epoxy System". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, to complete the Painting Coal Tar Epoxy System as specified in Section 09 97 02.01 12 PAINTING: COAL TAR EPOXY SYSTEM and as shown on the plans.

1.1.37 Exterior Signage

No separate measurement will be made for Exterior Signage. Payment shall be included in the contract lump sum price for "External Signage". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, to install External Signage as specified in Section 10 14 01 EXTERNAL SIGNAGE and as shown on the plans.

1.1.38 Metal Building Systems

No separate measurement will be made for Metal Building System. Payment for Metal Building System will be made at the contract lump sum price for "Metal Building Systems ". Price and payment shall constitute full compensation for furnishing all plant, labor, materials, equipment and tools but not limited to, structural steel, steel joist girder framing, structural framing, bracing, panel materials, bolts, nuts and washers, closure strips, anchor rods, threaded rods, steel hardware, power ventilators, louvers, firestopping, painting, and other incidentals required to complete the installation of metal building system as specified in SECTION 13 34 19 METAL BUILDING SYSTEMS and as shown on the plans.

1.1.39 Foundation Instrumentation

No separate measurement will be made for foundation instrumentation. Payment will be made at the contract lump sum price for "Foundation Instrumentation." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment and installing the Foundation instrumentation devices as specified in Section 13 50 00.00 12 FOUNDATION INSTRUMENTATION and as shown on plans.

1.1.40 Plumbing System at Pump Station

No separate measurement will be made for Plumbing system at pump station.
Payment will be made at the contract lump sum price for "Plumbing System at Pump Station." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, including, but not limited to, all piping, fittings, valves, flanges, pipe hangers and supports, wall faucets, yard faucets, hydrants, lavatory fixtures, backflow preventers, area drains, roof drains, pipe sleeves, escutcheon plates, and ancillary components required to install the Plumbing System At The Pump Station as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE and as shown on plans.

1.1.41 Vertical Pumps, Axial Flow

Measurement shall be made for the vertical pumps per each installed. Payment shall be made for the pumps at the applicable contract unit price per each for "Vertical Pumps, Axial Flow". Price and payment shall constitute full compensation for installation, furnishing all labor, materials, and equipment, including, but not limited to, all piping, fittings, flanges, and ancillary components required to connect the pumps to the platform, gear drive, and intake structure, as specified in Section 22 10 00.00 10 VERTICAL PUMPS, AXIAL FLOW and as shown on the drawings.

1.1.42 Natural Gas Fuel Piping System at Pump Station

No separate measurement will be made for Natural Gas Fuel Piping System at Pump Station. Payment will be made at the contract lump sum price for "Natural Gas Fuel Piping System at Pump Station." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, including, but not limited to, all gas piping, fittings, valves, flanges, flexible connectors, transition fittings, metering, regulators and shutoff valves, risers, pipe hangers and supports, pipe sleeves, and ancillary components required to install the Natural Gas Fuel Piping System at Pump Station as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE and as shown on plans.

1.1.43 Piping Specialties

No separate measurement and payment will be made for the installation of the piping specialties, appurtenant items, and accessories. Payment will be included in the applicable contract lump sum or unit prices for which the work is incidental thereto. Price and payment shall constitute full compensation for furnishing all plant, labor, materials, and equipment, including accessories, all as shown on the drawings and as specified in Section 23 20 00.00 12 PIPING SPECIALTIES.

1.1.44 Power Ventilators

No separate measurement and payment will be made for the installation of the Power Ventilators, appurtenant items, and accessories. Payment will be included in the applicable contract prices for which the work is incidental thereto. Price and payment shall constitute full compensation for furnishing all plant, labor, materials, and equipment, including accessories, for the installation of Power Ventilators at the pump station as specified in Section 23 34 23 POWER VENTILATORS, and as shown on the plans.

1.1.45 Electrical Work at Pump Station

No separate measurement will be made for Electrical Work at Pump Station. Payment will be made at the contract lump sum price for "Electrical Work
at Pump Station." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, including, but not limited to, wiring, cables, lighting fixtures, connections to devices, equipment, branch circuits, field runs, control devices, interior distribution system, motor control centers, switchboards, and panel boards, automatic transfer switches, bypass or isolation switches, cathodic protection, interior lighting, exterior lighting, power poles, exit signs, emergency lighting, low voltage motors, batteries, and connection to but not including source panels located in the electrical room and all other associated electrical work as specified in DIVISION 26 ELECTRICAL, and as shown on the plans.

1.1.46 Electrical Work at Headworks

No separate measurement will be made for Electrical Work at Headworks. Payment will be made at the contract lump sum price for "Electrical Work at Head Works." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, including, but not limited to, wiring, cables, lighting fixtures, connections to devices, equipment, branch circuits, field runs, control devices, interior distribution system, motor control centers, switchboards, and panel boards, automatic transfer switches, bypass or isolation switches, cathodic protection, interior lighting, exterior lighting, power poles, exit signs, emergency lighting, low voltage motors, batteries, and connection to but not including source panels located in the electrical room and all other associated electrical work as specified in DIVISION 26 ELECTRICAL, and as shown on the plans.

1.1.47 Separator Geotextile

Geotextile will be measured in place to the nearest square yard as delineated on the drawings. Overlaps will be measured as a single layer. Payment for the geotextile will be made at the applicable unit price per square yard for "SEPARATOR GEOTEXTILE". Price and payment shall include full compensation for providing all plant, equipment, labor and materials, and for cutting, sewing, placing, testing, taking corrective measures to fix deficiencies, and incidentals for installation of geotextile as specified in SECTION 31 05 19.04 12 SEPARATOR GEOTEXTILE, and as shown on the plans. No payment shall be made for geotextile that is rejected or damaged due to Contractor fault or negligence.

1.1.48 Geogrid Soil Reinforcement

Measurement for Geogrid Soil Reinforcement will be made by the square yards. Overlaps for splices (if allowed) and for the Contractor's convenience will not be measured for payment. Payment will be made at the contract unit price per square yard for "Geogrid Soil Reinforcement". Payment will be full compensation for furnishing all material, labor, equipment, supplies and incidentals to complete the installation of Geogrid Soil Reinforcement as specified in SECTION 31 05 21 GEOGRID SOIL REINFORCEMENT.

1.1.49 Clearing and Grubbing

No measurement will be made for clearing, grubbing, and vegetation removal. Payment for clearing, grubbing, and vegetation removal will be made at the contract lump sum price for "Clearing and Grubbing". Price and payment shall constitute full compensation for furnishing all plant, labor, material and equipment and performing all operations necessary for
clearing, grubbing, and vegetation removal of the areas indicated on the drawings and as specified in Section 31 11 00.00 12 CLEARING AND GRUBBING, for removing and disposing of all cleared, grubbed, and vegetation removal materials, and for filling holes resulting from grubbing operations, and placing embankment to replace earthen material removed as a result of vegetation removal operations.

1.1.50 Excavation

Measurement for Excavation will be made by the cubic yards. Payment will be made at the contract unit price per cubic yard for "Excavation". Price and payment shall constitute full compensation for furnishing all plant, labor, material and equipment and performing all operations necessary for excavation of the areas for degrading of existing river levee, excavation during different phases of construction at intake structure, headworks, pump station, conveyance channel, embankment cuts, U-channels, box culverts, access roads, road crossings, I-10 Hwy crossing, railroad crossings, and all other areas as indicated on the drawings and as specified in Section 31 23 00.00 12 EXCAVATION.

Quantities for excavation will be determined by the average end area method. The basis of measurement will be a survey of the area prior to excavation and the theoretical excavation lines and grade as shown on the drawings after completion of the excavation.

Contractor furnished Borrow pit development satisfactorily performed will not be measured for payment.

1.1.51 Structural Excavation and Backfill

No separate measurement will be made for structural excavation and backfill. Payment will be made at the contract lump sum price for "Structural Excavation and Backfill". Price and payment shall include full compensation for furnishing all materials, equipment and labor required for structural excavation and backfill as specified in Section 31 23 16.16 12 STRUCTURAL EXCAVATION AND BACKFILL and as shown on plans.

1.1.52 Dewatering

No separate measurement will be made for dewatering. Payment for dewatering will be made at the contract lump sum price for "Dewatering". Price and payment shall constitute full compensation for furnishing all plant, labor, material, and equipment; designing, furnishing, installing, maintaining, operating, flooding, rewatering, maintaining the dewatered area; and removing the dewatering facilities; and all work incidental thereto including construction of dikes, sumps, installation of wellpoints, jet eductors, wells, pumps, piezometers, removal of wellpoints, jet eductors, wells, and piezometers, plugging holes, maintaining protection dikes and closure dams, protection of slopes and all other work which may be necessary to accomplish the specified dewatering results and which is not specified to be paid for separately. Fifty percent of the lump sum price will be paid when installation of the dewatering system has been completed, tested, evaluated, and the piezometric level of the ground water has been lowered to the limits and elevations as specified. Forty percent of the lump-sum price will be prorated on the basis of the estimated number of months that dewatering system will be required and will be paid monthly. The remaining 10 percent of the lump-sum price will be paid when the dewatering system has been removed as required herein and cleanup in connection therewith has
been completed.

1.1.53 Embankment

Unless otherwise specified, compacted fill and required fill and backfill materials will be measured for payment by the cubic yard, and quantities will be determined by the average end area method. Payment will be made at the contract unit price per cubic yard for "Embankment, Compacted Fill." Price and payment shall constitute full compensation for furnishing all plant, labor, testing, employ of professional engineering services, equipment and material (except earth material), and performing all operations necessary for excavation, all testing, hauling, foundation preparation, material processing for moisture control and blending, placing and compacting the material and other incidental work required to complete the embankment or fill as specified in Section 31 24 00.00 12 EMBANKMENT and as shown on the plans.

(a) The basis for the measurement will be cross sections of the areas to be filled taken prior to clearing, grubbing, and vegetation removal operations and the theoretical design sections of the completed levee constructed within the specified tolerance. Embankment not constructed to design grade and section including allowable tolerance as indicated on the Contractor's compliance survey will not be accepted.

(b) Volumes occupied by drainage structures will not be included in measurement of embankment for payment.

(c) The basis for measurement of fill placed by reason of soft material in the foundation being forced outward from the section will be a survey of the area taken prior to the filling operations and a second survey of the same area after completion of the filling operations.

(d) Measurement of additional fill material placed in each settlement measurement range shown on the drawings by reason of foundation settlement will be based on measurements on the respective settlement gage installed.

(e) The cost of furnishing, installing, and maintaining during embankment construction the settlement gages, if used, including measurements required to be made by the Contractor shall be at the expense of the Contractor. No separate payment will be made for compaction of fills around and over the settlement gages or for interference with the Contractor's operations resulting from the settlement gage installations.

(f) The settlement measured at each settlement gage will be considered to apply to the foundation area throughout the length of the settlement ranges specified herein where the gage is located. In the event that embankment over a settlement gage is constructed to a height in excess of the specified design construction lines plus the tolerance permitted per specifications. No measurement of settlement will be made and will result in forfeiture of any payment that may be due the Contractor for the settlement range applying to that settlement gage. Further, in instances where settlement plates have been set and cannot be found after completion of the embankment, no measurement for settlement will be made, and any payment which may be due the Contractor for the settlement range applicable to that
(g) The Contractor will not be compensated for foundation settlement caused by moisture control operations performed on the existing berms. All initial settlement gage readings shall be taken prior to moisture control operations on the existing berms. In instances where the Contractor performs moisture control after the initial gage readings were taken, the Contractor shall perform settlement gage readings prior to commencing moisture control operations in the area to receive compensation for settlement in that area and if no measurement is taken for settlement any payment which may be due the Contractor for the settlement range applicable to that settlement gage will be forfeited. The Contractor may seek compensation for settlement after all moisture control operations have terminated and new settlement gage readings are performed in the area.

(h) No separate measurement will be made for embankment material testing regardless of the location (i.e., in the borrow area, stockpile area, or in-place) of the material. Payment for all compacted fill material placed as required in embankments, berms, ramps, fill and backfill, and including additional material placed by reason of foundation settlement and by reason of soft material in the foundation being forced outward from the section during construction, will be made at the contract unit price per cubic yard for "Embankment, Compacted Fill".

(i) Failure to utilize settlement gages in strict accordance with the specifications and drawings will result in total forfeiture of any payment that may otherwise be due the Contractor for settlement of the foundation.

1.1.54 Deep Mixed Columns

No separate measurement will be made for deep mixed columns. Payment for the deep mixed columns will be made at the contract lump sum price for "Deep Mixed Columns". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment to install the Deep Mixed Columns in accordance with Section 31 32 13.00 16 CEMENT SOIL STABILIZATION and as shown on plans, including testing and removal of spoil from the job site.

1.1.55 Riprap

Measurement of riprap will be made by the cubic yard. Measurement shall be of in-place material to the dimensions shown on the drawings. Payment for installation of riprap and other incidental work will be made at the contract unit price per cubic yard for "Riprap (Class 30 lb)"", "Riprap (Class 55 lb)"", "Riprap (Class 130 lb)"", and "Riprap (Class 250 lb)". Prices and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment and performing the work, including any necessary repairs, as specified in Section 31 37 00.01 12 RIPRAP, and as shown on the plans.

1.1.56 Grouted Riprap

Measurement of grouted riprap will be made by the cubic yard. Measurement shall be of in-place material taken subsequent to grouting and shall be limited, where applicable, to the dimensions shown on the drawings. Payment for installation of grouted riprap and other incidental work will
be made at the contract unit price per cubic yard for "Grouted Riprap."
Price and payment shall constitute full compensation for furnishing all
plant, labor, materials and equipment and performing the work, riprap and
grout mix, including any necessary repairs, as specified in Section
31 37 00.02 12 GROUNTED RIPRAP, and as shown on the plans.

1.1.57 Steel Sheet Piling

Measurement of driven steel sheet piling, will be made by the square foot
of piling acceptably installed. Payment for installation of steel sheet
piling and other incidental work will be made at the contract unit price
per square foot of "Steel Sheet Piling, Type PZ-22", "Steel Sheet Piling,
Type PZ-27", and "Steel Sheet Piling, Type PZ-72". Price and payment
shall constitute full compensation for furnishing all plant, labor,
materials and equipment and performing the work, including, but not
limited to sheet piling, fabricated piles (special corners, transitions,
te sections, etc.) and rolled corners, sheet piling void backfill, and
any necessary repairs, as specified in Section 31 41 16.00 12 STEEL SHEET
PILING, and as shown on the plans.

(a) The length of each pile driven will be measured to the nearest
ten of a linear foot and converted to square feet for payment
purposes. The square footage will be determined by multiplying the
number of piles times the measured length acceptably driven below the
cut-off elevation shown on the drawings times the theoretical driving
width of the pile. The number of piles paid for shall not exceed the
number of piles indicated on the drawings. When driven piles are
directed to be cut off before reaching the penetration depth shown on
the drawings, that portion cut off will be measured for payment on the
basis of its total length, provided that the length is not greater
than the difference between the total length of piles shown on the
plans for that location and the length of piles driven below the
cut-off elevation. No deduction will be made for holes cut for drains
and utilities in computing the area of steel sheet pile structures.
The portion of any pile driven below the tip elevation shown on the
drawings will not be measured for payment unless overdriving is
directed by the Government Representative.

(b) Piles ordered pulled will be measured for payment by the square
foot. Square footage will be determined by multiplying the
theoretical driving width of the pile by the length pulled above the
cut-off elevation shown on the drawings. Re-driving of such piles,
when required, shall be measured for payment by the square foot, which
shall be determined by multiplying the theoretical driving width of
the pile by the length re-driven below the cut-off elevation shown on
the drawings.

(c) Cut-offs and/or splices which are not required under the
original terms of this contract but become necessary to construct the
sheet pile structures as shown on the drawings and as specified, and
which are necessitated due to Contractor negligence in any procedure
required to install such structures shall be provided at no additional
cost to the Government. Cut-offs and/or splices of this type which
are required through no fault of the Contractor shall be paid for by
lump sum payments of $15.00 per cut-off and $15.00 per splice.
Additionally, the portion of a Contractor furnished pile which is cut
off when the Contractor is deemed to be not at fault, shall be paid
for at 75 percent of the applicable contract unit price for the amount
measured in accordance with above paragraph "Measurement."
1.1.58  Prestressed Concrete Piles

Precast prestressed concrete piles will be measured for payment on the basis of linear foot lengths along the axis of the pile in place below the cut-off elevation and shall be limited to the lengths as shown on the drawings. Payment will be made at the contract unit price per linear foot for "Prestressed Concrete Piles, Type 14"x14"", "Prestressed Concrete Piles, Type 18"x18". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment and performing the work, including, but not limited to prestressed concrete piles, fabricated items, void backfill, and any necessary repairs, as specified in Section 31 62 13.20 12 PRESTRESSED CONCRETE PILES, and as shown on the plans.

(a) Pile lengths will be measured to the nearest tenth of a foot. The portion of any pile driven below the tip elevation shown on the drawings will not be measured for payment unless overdriving is directed by the Government Representative.

(b) Pulled piles shall be measured for payment on the basis of lengths along the axis of the pile pulled above the cut-off elevation. Redriving of pulled piles will be measured in accordance with the provisions stated herein above for originally driving the piles. Cut offs shall be measured for payment on the basis of total length minus driving head length provided that this length is not greater than the difference between the total length of piles shown on the plans for that location and the length of piles driven below the point of cut off.

1.1.59  Pile Load Tests

Pile Load Tests will be measured by the number of pile tests performed. Payment for compression pile test and/or tension pile test will be made at the applicable contract unit price per each for "Compression Pile Load Tests". Price and payment shall constitute full compensation for performing load test including calibration of the extensometers, load cell, and hydraulic jack; driving all reaction/support piling; placing and removing load frame for each test; placing and removing test loads and test equipment; extracting reaction or support piles; backfilling pulled pile holes; submission of load test results/report; and all operations incidental thereto as specified in SECTION 31 62 14.00 12 PILE LOAD TESTS, and as shown on the plans.

1.1.60  Steel H-Piles

Measurement for steel H-piling shall be made by the linear foot. Payment for steel H-piling shall be made at the contract unit price per linear foot for "Steel H-Piles, HP 14 x 89", and "Steel H-Piles, HP 16 x 101". Price and payment shall constitute full compensation for furnishing all plant, labor, equipment, material, splices, tension connectors, and all other costs incidental to install the steel H-piling as specified in Section 31 62 16.00 12 STEEL H-PILES, and as shown on the drawings.

1.1.61  Steel Pipe Pile

Measurement for furnishing, placing and installing steel H-piling shall be made by the linear foot. Payment for furnishing, placing and installing steel pipe piling shall be made at the contract unit price per linear foot
for "Steel Pipe piles, 24" Diameter". Price and payment shall constitute full compensation for furnishing all plant, labor, equipment, material, splices, tension connectors, and all other costs incidental to install the Steel Pipe Piles as specified in Section 31 62 17.00 12 STEEL SPIRAL OR LONGITUDINALLY WELDED PIPE PILES, and as shown on the drawings.

1.1.62 Timber Piles

Timber piles will be measured for payment on the basis of lengths, to the nearest tenth of a linear foot, along the axis of each pile acceptably in place below the cutoff elevation shown on the contract drawings. Payment for will be made at the contract unit price per linear foot for "Timber Piles, 12" Diameter". Price and payment shall constitute full compensation for all costs of furnishing and delivering piles to work site, handling, driving, measuring heave, re-driving heaved piles, cutting off piles at the cutoff elevation, compiling and submitting pile driving records, backfilling voids around piles, steel uplift connectors and any other items incidental thereto as specified in Section 31 62 20.00 12 TIMBER PILES, and as shown on the plans.

(a) Payment for timber piles pulled at the direction of the Government Representative and found to be undamaged will be made by an equitable adjustment.

(b) No payment will be made for furnishing, delivering, driving, pulling, and disposing of piles pulled and found to be damaged. New piles replacing damaged piles, respectively, will be paid for at the applicable contract unit price.

1.1.63 Asphaltic Pavement

Measurement for asphaltic pavement will be made by the ton. Payment will be made at the contract unit price per ton for "Asphaltic Pavement." Price and payment shall constitute full payment for furnishing all plant, labor, materials, base, sub-base, asphaltic pavement, testing, and equipment to complete the work as specified in Section 32 12 16.00 12 ASPHALTIC PAVEMENT, and as shown on the drawings.

1.1.64 Crushed Stone Surfacing

Surfacing material required for the access ramps, new road, existing road, levee crown, and temporary detours including their maintenance shall be measured by the cubic yard. Payment for the surfacing materials required for the surfacing and maintenance of the temporary detour and access ramps, and all the costs associated therewith shall be made at the contract unit price per ton for "Crushed Stone Surfacing". Price and payment shall constitute full compensation for subgrade preparation; furnishing all plant, labor, equipment, and materials; placing, spreading, compacting, and maintenance as as specified in Section 32 15 00.00 12 SURFACING (GRANULAR), and as shown on the drawings.

(a) Vehicle Delivery - Measurement will be made by the cubic yard in approved vehicles at the site of the work. Allowance will not be made for wastage or shrinkage during transportation from car or other point of loading. Approved vehicles for this purpose may be of any type acceptable to the Government Representative. The body shall be that of any shape that the actual delivered contents may be readily and accurately determined and will remain constant. Unless all approved vehicles for the work are of uniform capacity, each vehicle must bear
a plainly legible identification mark indicating its approved capacity. The Government may reject all loads hauled in non-approved vehicles. Upon delivery of each load at the jobsite and prior to the Contractor's measurement of each load, the Contractor shall "level-off" each load within the approved vehicles so that an accurate measurement of each load can be made. After leveling off the load, the Contractor's Quality Control personnel shall measure each load at the site of work. The Government will inspect each load, check its yardage and witness the Contractor's measurement of each load.

1.1.65 Pavement Markings

No separate measurement will be made for pavement markings (reflectorized or non-reflectorized, raised or not raised pavement markings, plastic pavement markings, temporary and permanent) furnished, placed, and accepted as specified herein and as shown on the drawings. Payment for pavement markings (reflectorized and non-reflectorized, raised or not raised pavement markings, plastic pavement markings, temporary and permanent) shall be made at the contract lump sum price for "Pavement Markings". Price and payment shall be full compensation for furnishing all plant, labor, materials, equipment and all other work incidental thereto as specified in Section 32 17 23.00 20 PAVEMENT MARKINGS and as shown on the plans.

1.1.66 Vehicular Precast Concrete Bridge and Platform

No separate measurement will be made for the vehicular precast concrete bridge and platform. Payment for the precast concrete bridge will be made at the contract lump sum price for "Vehicular Precast Concrete Bridge and Platform." Price and payment shall constitute full compensation for all materials, equipment, tools, labor and incidentals and for performing all work necessary to deliver, form, place reinforcing and precast pile caps, furnish, deliver and install precast deck units with concrete guardrails, place fill: construct reinforced portland cement concrete approach slabs and abutments including all necessary structural excavation; and all other work incidental to installing the new bridge except for piling as specified in SECTION 32 34 00.03 00 VEHICULAR PRECAST CONCRETE BRIDGE AND PLATFORM, and as shown on the plans.

1.1.67 Chainlink Fence and Gate

Measurement for chain link fence and gate will be made by the linear foot of chain link fence and gate satisfactorily installed. Payment for furnishing and installing chain link fence and gate will be made at the contract unit price per linear foot for "Chain Link Fence and Gate". Price and payment shall constitute full compensation for furnishing all plant, labor, equipment, material and all other costs incidental thereto as specified in Section 32 31 13 CHAIN LINK FENCES AND GATES, and as shown on the plans.

1.1.68 Turf Establishment and Maintenance

Measurement for Turf Establishment and Maintenance will be made per Acre. Payment for Turf Establishment and Maintenance will be made at the contract unit price per Acre for "Turf Establishment and Maintenance ". Price and payment shall constitute full compensation for furnishing all plant, labor, equipment, material, including seeding, mulching and fertilizing, lime soil amendment, sulfur soil amendment, testing, and all other costs incidental thereto as specified in Section 32 92 19.04 12 TURF
ESTABLISHMENT AND MAINTENANCE, and as shown on the plans.

1.1.69 Modifications to Existing Utilities

Modifications to existing utilities will not be measured for payment. Payment for modifications to existing utilities will be made at the contract lump sum price for "Modifications to Existing Utilities." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment to excavate, modify existing utilities, backfill, remove abandoned pipes, provide temporary pipe supports and incidentals to complete the work as specified in Section 33 05 00.00 12 MODIFICATIONS TO EXISTING UTILITIES, and as shown on the contract drawings.

1.1.70 Steel Discharge Pipe

Measurement for steel discharge pipe will be made by linear foot. The length of steel pipe will be determined by measuring along the centerlines of the various sizes of pipe furnished and installed. Pipe will be measured from center of fitting to center of fitting. No deduction will be made for the space occupied by valves or fittings. Payment will be made at contract unit price per linear foot for "Steel Discharge Pipe, 48" Diameter. Price and payment shall include all plant, labor, materials and equipment, steel pipe, eccentric diffuser, flexible coupling dresser style, appurtenances, welding, and incidentals for installation of steel pipe, as specified in Section 33 11 00 LARGE DIAMETER STEEL PIPE, and as shown on the plans.

1.1.71 New Water Main

Measurement of new water main shall be made per linear foot of each type of waterline installed as measured along the centerline of the pipe. Payment will be made at the applicable contract unit price per linear foot for "New Water Main". Price and payment shall constitute full compensation for furnishing all plant, labor, materials of the size specified including excavation, complete shoring, foundation lumber, bedding, installation of new pipe, tie-in, hot tapping sleeve, valve, valve manhole, fire hydrant, fittings, offsets, backfill, hydrostatic testing; chlorination of the water main, coordination with Parish for chlorination testing and valve closures during water main tie-in to existing pipe and all work incidental thereto as specified in Section 33 11 00.01 WATER DISTRIBUTION, and as shown on the plans.

1.1.72 Storm Drain Pipes

Measurement for storm drain pipes will be made per linear foot. The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe. Payment will be made at the contract unit price per linear feet for "Storm Drain Pipes" placed. Price and payment shall include all plant, labor, materials and equipment as specified in Section 33 40 00 STORM DRAIN UTILITIES, and as shown on the plans.

1.1.73 Elastomeric Check Valves

Measurement for elastomeric check valves will be made per each size. Payment will be made at the contract unit price per each for "Elastomeric Check Valves, 42" Dia. w/ 44"x55" Elliptical Cuff", and "Elastomeric Check Valves, 36" Dia.". Price and payment shall include all plant, labor, materials and equipment as specified in Section 33 40 00 STORM DRAIN UTILITIES, and as shown on the plans.
1.1.74  Speed Reducers for Storm Water Pumps

Measurement for speed reducers for storm water pumps will be measured for payment per each. Payment will be made at the contract unit price per each for "Speed Reducers for Storm Water Pumps". Price and payment shall include all plant, labor, materials and equipment as specified in Section 33 45 00.00 10 SPEED REDUCER FOR STORM WATER PUMPS, and as shown on the plans.

1.1.75  Fuel Service Piping at Pump Station

No separate measurement will be made for Fuel Service Piping at Pump Station. Payment will be made at the contract lump sum price for "Fuel Service Piping at Pump Station." Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment, including, but not limited to, all piping, fittings, valves, flanges, pipe hangers and supports, wall faucets, yard faucets, cathodic protection, and ancillary components required to install the Fuel Service Piping at Pump Station as specified in Section 33 52 10 SERVICE PIPING, FUEL SYSTEMS and as shown on plans.

1.1.76  New Gas Main

No separate measurement will be made for new gas main. Payment will be made at the applicable contract lump sum price for "New Gas Main". Price and payment shall constitute full compensation for furnishing all plant, labor, materials of the size specified including excavation, complete shoring, foundation lumber, bedding, installation of new gas pipe, fittings, offsets, backfill, welding, testing; coordination with utility owner and all work incidental thereto as specified in 33 52 10 SERVICE PIPING, FUEL SYSTEMS, and as shown on the plans.

1.1.77  Railroad Falsework at KCS AND CN Railroad

No measurement will be made for the construction and removal of the falsework structures. Payment for the construction and removal of the falsework structures will be made at the applicable contract lump sum price for "Railroad Falsework at KCS Railroad", and "Railroad Falsework at CN Railroad". Price and payment shall constitute full compensation for furnishing all plant, labor, material, and equipment required for the construction and removal of the temporary railroad falsework as specified in Section 34 11 00.01 CONSTRUCTION ON OR ADJACENT TO RAILROAD TRACKS, and as shown on the plans.

(a)  Steel H-Piling for Falsework

The steel H-piling will be measured and paid for in accordance with Section 31 62 16.00 12 "STEEL H-PILES."

(b)  Steel Sheet Piling

The steel sheet piling will be measured and paid for in accordance with Section 31 41 16.00 12 "STEEL SHEET PILING."

1.1.78  Ballast and Sub-Ballast at KCS Railroad

Ballast and Sub-Ballast will not be measured for payment. Payment for Ballast and Sub-Ballast will be made at the contract lump sum price for
"Ballast and Sub-Ballast at KCS Railroad", and "Ballast and Sub-Ballast at CN Railroad". Price and payment shall constitute full compensation for furnishing all plant, labor, material and equipment required for construction of the ballast and sub-ballast.

1.1.79 Railroad Flagman

No measurement will be made for Railroad Flagman. Payment for Railroad Flagman will be made at the contract lump sum price for "Railroad Flagman at KCS Railroad", and "Railroad Flagman at CN Railroad". Price and payment shall constitute full compensation for furnishing all plant, labor, material, and equipment required for providing Railroad Flagman all in accordance with GENERAL PROVISIONS Section, Paragraph "Work on or Adjacent to Railroad Tracks (KCS and CN)".

1.1.80 Railroad Insurance

No measurement will be made for providing the required railroad insurance. Payment for required railroad insurance will be made at the contract lump sum price for "Railroad Insurance for KCS Railroad", and "Railroad Insurance for CN Railroad". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment required for providing the required railroad insurance all in accordance with GENERAL PROVISIONS Section, Paragraph "Work on or Adjacent to Railroad Tracks (KCS and CN)".

1.1.81 Demolition of Existing Railroad Tracks

No measurement will be made for Demolition of Existing Railroad Tracks. Payment will be made at the contract lump sum price for "Demolition of Existing KCS Railroad Tracks", and "Demolition of Existing CN Railroad Tracks". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment required for Demolition of Existing Railroad Tracks as specified in Section 34 11 00.01 CONSTRUCTION ON OR ADJACENT TO RAILROAD TRACKS, and as shown on the plans.

1.1.82 New Railroad Tracks

Measurement will be made per Track Foot for New Railroad Tracks. Payment will be made at the contract unit price for "New KCS Railroad Tracks", and "New CN Railroad Tracks". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment required for installation of New Railroad Tracks as specified in Section 34 11 00.01 CONSTRUCTION ON OR ADJACENT TO RAILROAD TRACKS, and as shown on the plans.

1.1.83 Shoofly at CN Railroad

No measurement will be made for shoofly at CN Railroad. Payment will be made at the contract lump sum price for "Shoofly at CN Railroad". Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment required for installation of Shoofly at CN Railroad as specified in Section 34 11 00.01 CONSTRUCTION ON OR ADJACENT TO RAILROAD TRACKS, and as shown on the plans.

1.1.84 Sluice Gates and Hydraulic Operated Actuators

Sluice gates, central hydraulic power unit and hydraulic valve actuators will be measured per each. Payment will be made at the contract unit...
price for "Sluice Gates and Hydraulic Operated Valve Actuators". Price and payment shall constitute full compensation for furnishing all plant, labor, material and equipment and designing, manufacturing, assembling, factory testing, preserving, delivering, storing, installing and field testing the gates, central hydraulic power unit and hydraulic valve actuators, beams, angles, plates, skinplates, rubber seals, seal plates and angles, studs, hinges, fasteners, stems, operators, operator pedestals, and welding including painting and all appurtenant items, services, parts and incidentals thereto as specified in Section 35 20 16.26 12 SLUICE GATES AND HYDRAULIC OPERATED ACTUATORS, and as shown on the plans.

1.1.85 Gate Valves

Gate Valves will be measured per each. Payment will be made at the contract unit price for "Gate Valves". Price and payment shall constitute full compensation for furnishing all plant, labor, material and equipment and factory testing, preserving, delivering, storing, installing and field testing the gate valves, and incidentals thereto as specified in Section 35 20 19.00 12 GATE VALVES, and as shown on the plans.

1.1.86 Stone and Bedding Construction

Stone Bedding will be measured by the cubic yard of bedding satisfactorily placed. Payment will be made at the contract unit price for "Stone Bedding". Price and payment shall constitute full compensation for furnishing all plant, labor, material and equipment to place stone bedding and incidentals thereto as specified in Section 35 31 19.04 12 STONE AND BEDDING CONSTRUCTION, and as shown on the plans.

(a) Barge Delivery - If delivery is made by barge and material is put in final placement directly from the barge, volume shall be determined by on-deck measurement. In the event that material is piled in such form as to make on-deck measurement impracticable or unduly difficult, the Contractor shall reshape the load as directed by the Government Representative into suitable form before measurement. If the material is not put in final placement directly from the barge, on-deck measurement will not be made. When materials are stockpiled and/or vehicle loaded prior to final placement, measurement will be made in accordance with paragraph "Vehicle Delivery."

(b) Vehicle Delivery - If delivery is made by vehicle, measurement will be made by the cubic yard in approved vehicles at the site of the work. Allowance will not be made for wastage or shrinkage during transportation from car or other point of loading. The Government will inspect each load and check its yardage. Approved vehicles for this purpose may be of any type acceptable to the Government Representative. The body shall be such shape that the actual delivered contents may be readily and accurately determined and will remain constant. Unless all approved vehicles for the work are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its approved capacity. The Government may reject all loads hauled in non-approved vehicles.

1.1.87 MSE Wall/Reinforced Soil Slope

MSE Wall/Reinforced Soil Slope will be measured per cubic yard (CY). Payment will be made at the contract unit price per cubic yard for "MSE Wall/Reinforced Soil Slope". Payment will be full compensation for
furnishing all material, labor, equipment, compacted fill material, geotextile or geogrid reinforcement, hand compaction, and incidentals to complete the work as specified in Section 35 24 34 REINFORCED SOIL SLOPE, and as shown on the plans.

1.1.88 Concrete Slope Pavement

Paving will be measured by the square (100 square feet) of paving placed in accordance with the details shown on the drawings. Measurement will be made to the nearest 1/10 foot and units computed to the nearest one-hundredth of a square. To allow for the cut off wall, one additional square will be allowed for each 57 linear feet of satisfactorily completed cut off wall. Payment for paving will be made at the contract price per square for "Concrete Slope Pavement". Price and payment shall include the cost of preparation, maintenance and restoration of levee slope, crown backfilling, the toe trench excavation and backfill, cutoff wall trench excavation and backfill and other work incidental thereto, including making, curing, protecting and transporting concrete cylinders, coring, filling core holes, sealing joints and furnishing all plant, labor and materials (including concrete) used in the construction of the slope pavement as specified in Section Concrete Slope Pavement, and as shown on the plans.

1.1.89 Diesel-generator Set Standby

Diesel-generator Set Standby will be measured per each. Payment will be made at the contract unit price per each for "Diesel-generator Set Standby". Payment will be full compensation for furnishing all material, labor, equipment, and incidentals to complete the work as specified in Section 26 32 14.00 10 DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS, and as shown on the plans.

1.1.90 Overhead Electric Bridge Crane, Top Running

Overhead Electric Bridge Crane will be measured per each. Payment will be made at the contract unit price per each for "Overhead Electric Bridge Crane". Payment will be full compensation for furnishing all material, labor, equipment, and incidentals to complete the work as specified in Section 41 22 13.14 BRIDGE CRANES, OVERHEAD ELECTRIC, TOP RUNNING, and as shown on the plans.

1.1.91 Natural Gas Fueled Engine Pump Drive

Natural Gas Fueled Engine Pump Drive will be measured per each. Payment will be made at the contract unit price per each for "Natural Gas Fueled Engine Pump Drive". Payment will be full compensation for furnishing all material, labor, equipment, and incidentals to complete the work as specified in Section 41 65 10.00 10 NATURAL GAS FUELED ENGINE PUMP DRIVE, and as shown on the plans.

1.1.92 Flow Measuring Equipment System

No measurement will be made for Flow Measuring Equipment System. Payment will be made at the contract lump sum price for "Flow Measuring Equipment System". Payment will be full compensation for furnishing all material, labor, equipment, and incidentals to complete the work as specified in Section 43 21 29 FLOW MEASURING EQUIPMENT, and as shown on the plans.
1.1.93 Sewage Aeration Treatment System

No measurement will be made for Sewage Aeration Treatment System. Payment will be made at the contract lump sum price for "Sewage Aeration Treatment System". Payment will be full compensation for furnishing all material, labor, equipment, and incidentals to complete the work per the detail as shown on the plans.

1.1.94 Boat Launch and Dock

No measurement will be made for Boat Launch and Dock. Payment will be made at the contract lump sum price for "Boat Launch and Dock". Payment will be full compensation for furnishing all material, labor, equipment, and incidentals to complete the work per the detail as shown on the plans.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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DIVISION 01 - GENERAL REQUIREMENTS

CONSTRUCTION PROGRESS DOCUMENTATION

04/06

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   GENERAL

The scheduling of all procurement and construction activities shall be the responsibility of the Contractor. All construction increments will be interrelated on a single schedule that represents the entire project duration from the notice to proceed (NTP) to the Contract Completion Date.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)


1.4   SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction schedule; G

1.5   CONSTRUCTION SCHEDULE

Submit within ten (10) calendar days after NTP for approval a construction schedule in the form of a Critical Path Method (CPM), Network Schedule in accordance with the terms in Section 00700 Standard General Conditions, Article 2.07.

1.6   NETWORK ANALYSIS SCHEDULE (NAS)

The schedule shall be the basis for determining progress and therefore the amount of each progress payment. No progress payments will be made without the submittal of an acceptable schedule or update. The Contractor shall use the critical path method (CPM) to schedule and control construction activities. The network may utilize either the I-J or
Precedent Diagramming method and shall show the order and interdependence of activities in which the work is to be performed. The schedule shall be developed to an appropriate level of detail. Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Generally, less than 2 percent of all non-procurement shall have a duration greater than 21 calendar days. The work activity durations must consider all adverse weather impacts that are anticipated during the period the activity is scheduled to be in progress. The schedule shall identify as a minimum:

a. Activity description;

b. Activity duration;

c. Activity cost;

d. Responsibility code assigning activities to the Prime Contractor, Subcontractor or Government agency responsible for the activity;

e. Critical Path;

f. Major submittals and submittal processing time; and

g. Any material with a lead-time of greater than 30 calendar days.

1.6.1 CPM Submittals and Procedures

The Contractor shall load the schedule data into the Construction Contractor module of Resident Management System (RMS), as described in Specification Section 01 45 02.00 10, QUALITY CONTROL SYSTEM (QCS) prior to the database being transferred to the Government. This data transfer may be accomplished electronically by using a NAS scheduling software system that meets the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11. If the Contractor selects a NAS scheduling software system that is not Standard Data Exchange Format (SDEF) compliant, then the Contractor shall perform this data transfer from the schedule into the QUALITY CONTROL SYSTEM (QCS) manually. This is considered to be additional supporting data in a form and detail required by the Government Representative. The receipt of a proper payment request is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application for progress payment.

1.7 UPDATED SCHEDULES

Update the construction schedule at monthly intervals or more frequently when revisions are required to the schedule. The network analysis system shall be kept current, with changes made to reflect the actual progress status of the construction.

1.7.1 Periodic Schedule Update Meetings

At bi-weekly intervals, the Contractor (consisting of as a minimum, the Project Manager) and Government representatives will meet to jointly update the project schedule. The purpose of the meeting is a working interactive exchange to determine earned value amounts for each activity, allow all parties to evaluate project status as of the data date, provide a complete and accurate update of the procurement and construction progress, review the Contractor's proposed out of sequence corrections,
determine causes for delay, correct logic, maintain schedule accuracy, create a historical record of the project and establish prediction of completion dates based upon current status. The Contractor is responsible to gather all supporting documentation, present the update data for the schedule and record the meeting minutes in the narrative report. All progress payment earned value amounts will be derived from and tied to the cost-loaded schedule activities. During this meeting, the Contractor shall describe, on an activity-by-activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Government Representative will approve activity progress, proposed revisions, and adjustments as appropriate. The meeting to update the schedule and the post-meeting submission of an error free, acceptable updated schedule and narrative report to the Government is a condition precedent to the submission of an invoice for progress payment.

1.7.2 Narrative Report

The Contractor shall provide a comprehensive and meaningful narrative report with each update of the project schedule. The narrative report is important to indicate that the Contractor has reviewed and evaluated the updated schedule and has developed a plan to recover the original schedule (if applicable) and is planning the work activities and resources to accomplish the remaining scheduled work. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the critical paths and the near critical paths (total float 1 - 14 days), a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis. The evaluation shall include a review of actual activity durations and crew loadings compared to the scheduled durations and crew loadings for critical and near critical activities. If the Contractor believes that any Government action or inaction has, or potentially will impact its progress, it will include the specific notice of the fact in this report. This information should include the activity number(s) of the impacted work with the nature and duration of the impact. The narrative report shall also address all modifications and weather activities that were input for the progress and their impact on the contract completion and total float.
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PART 2   PRODUCTS (NOT USED)

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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 GENERAL

The Contractor shall submit all items listed on the Submittal Register or specified in the other sections of these specifications. The Contractor shall make submittals as required by the specifications. The Government Representative may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. An original, seven (7) copies, and an electronic copy shall be made and submitted to the Government Representative. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O & M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 DEFINITIONS

1.3.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by SD numbers and titles as follows.

SD-01 Preconstruction Submittals

- Certificates of insurance.
- Surety bonds.
- List of proposed subcontractors.
- List of proposed products.
- Construction Progress Schedule.
- Submittal register.
- Schedule of prices.
Health and safety plan.
Work plan.
Quality control plan.
Environmental protection plan.

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accordance with specified requirements. (Testing must have been within three (3) years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.
Report which includes finding of a test made at the job site or on a sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This Data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals
1.3.2 Approving Authority

Office or designated person authorized to approve submittal.

1.3.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal register; G

1.5 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.5.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Government Representative. Within the terms of the Section 00700 Standard General Conditions.

1.5.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.6 APPROVED SUBMITTALS

The Government Representative's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Government Representative, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.
1.7 DISAPPROVED SUBMITTALS

The Contractor shall respond to all concerns expressed by the Government Representative and promptly make any corrections necessary to address those concerns. The Contractor shall promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause in Section 00700 Standard General Conditions, Article 10.

1.8 SUBMITTAL REGISTER

At the end of this section is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this submittal register may not be all inclusive and additional submittals may be required. The Contractor shall maintain a submittal register for the project in accordance with Section 01 45 02.00 10 QUALITY CONTROL SYSTEM (QCS). The Government will provide the initial submittal register in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall track all submittals.

1.9 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of five (5) calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

1.10 TRANSMITTAL FORM

The transmittal form attached to this section shall be used for submitting both Government-approved and information-only submittals in accordance with the instructions on the reverse side of the form. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the contract specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

1.11 SUBMITTAL PROCEDURES

Submittals shall be made as follows:

1.11.1 Procedures

Procedures for submittals will be stipulated by the Government Representative at the preconstruction conference.

1.11.2 Deviations

For submittals which include proposed deviations requested by the
Contractor, the column "variation" shown in the form shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.12 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.13 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Five (5) copies of the submittal will be retained by the Government Representative and two (2) copies of the submittal will be returned to the Contractor.

1.14 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Government Representative is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Government Representative from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.15 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:
CONTRACTOR

(Firm Name)

_____ Approved

_____ Approved with corrections as noted on submittal data and/or attached sheets(s).

SIGNATURE: __________________________________________________________

TITLE: ________________________________________________________________

DATE: _________________________________________________________________

PART 2   PRODUCTS (NOT USED)

PART 3   EXECUTION (NOT USED)

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### Activity: Preconstruction Submittals

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### Activity: Product Data

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### Activity: Coating

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### Activity: Manufacturer's Technical Data

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### Activity: Textured Wall Coating System

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### Activity: Color

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### Activity: Heat-Resistant Coatings

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### Activity: Epoxy Coatings

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- **Material Needed By:**
- **Date of Action:**
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- **Date Rcd From Other Reviewer:**
- **Date Rcd Frm Appr. Auth.:**
- **Date Mailed To Contr.:**
- **Remarks:**

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- **Material Needed By:**
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- **Date Rcd From Other Reviewer:**
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**SUBMITTAL REGISTER**

**Title and Location:** River Re-Introduction Into Maurepas Swamp

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

07/06

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1.1   REFERENCES
1.2   ORDERING INFORMATION

-- End of Section Table of Contents --
PART 1  GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.concrete.org

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: http://www.amca.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Fax: 703-528-2148
E-mail: isea@safetyequipment.org
Internet: http://www.safetyequipment.org/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Lane
Piscataway, NJ 08855-1331
Ph: 732-981-0060
Fax: 732-981-1712
E-mail: customer-services@ieee.org
Internet: http://www.ieee.org

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 770-830-0369
Fax: 770-830-8501
Internet: http://www.icea.net

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
(IAPMO)
5001 E. Philadelphia St.
Ontario, CA 91761
Ph: 909-472-4100
Fax: 909-472-4150
E-mail: iampo@iampo.org
Internet: www.iampo.org

INTERNATIONAL CODE COUNCIL (ICC)
5360 Workman Mill Road
Whittier, CA 90601
Ph: 562-699-0541
Fax: 562-699-9721
E-mail: webmaster@iccsafe.org
Internet: www.iccsecure.org

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)
3166 South River Road, Suite 132
Des Plaines, IL 60018
Ph: 847-827-0830
Fax: 847-827-0832
Internet: http://www.icri.org

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
P.O. Box 687
106 Stone Street
Morrison, CO 80465
Ph: 303-697-8441
Fax: 303-697-8431
E-mail: neta@netaworld.org
Internet: http://www.netaworld.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
1, rue de Varembe'
Case Postale 56
CH-1211 Geneve 20 Switzerland
Ph: 41-22-749-0111
Fax: 41-22-733-3430
E-mail: central@iso.ch
Internet:  http://www.iso.ch

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)
3000 Lakeside Drive, 309S
Bannockburn, IL  60015
Ph:   847-615-7100
Fax:   847-615-7105
Internet: http://www.ipc.org
e-mail: orderipc@ipc.org

ISA - INTERNATIONAL SOCIETY OF AUTOMATION(ISA)
67 Alexander Drive
Research Triangle Park, NC  27709
Ph:   919-549-8411
Fax:   919-549-8288
E-mail: info@isa.org
Internet: http://www.isa.org

LOUISIANA ADMINISTRATIVE CODE (LAC)
Office of State Register
P.O. Box 94095
Baton Rouge, LA 70804-9095
Ph: 225-342-5015
Internet:

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT (LADOTD)
P.O. Box 94245
Baton Rouge, LA 70804-9245
Ph: 225-379-1200
Fax: 225-379-1851
Internet:

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ)
P.O. Box 4301
Baton Rouge, LA 70821-4301
Ph: 225-219-3953
Fax: 225-219-3971
Internet:

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA  22180-4602
Ph:   703-281-6613
Fax:   703-281-6671
E-mail: info@mss-hq.com
Internet:  http://www.mss-hq.com

MASTER PAINTERS INSTITUTE (MPI)
4090 Graveley Street
Burnaby, BC CANADA V5C 3T6
Ph: 888-674-8937
Fax: 888-211-8708
E-mail: info@paintinfo.com
Internet:  http://www.paintinfo.com/mp

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)
1300 Sumner Avenue
Cleveland, OH  44115-2851
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: http://www.ntis.gov

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)
Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C
Gastonia, NC 28054-2193
Ph: 704-810-8870
Fax: 704-852-4189
Internet: http://www.ams.usda.gov/lsg/seed.htm
E-mail: seed.ams@usda.gov

Order Other Publications from:
U.S. Department of Agriculture, Rural Utilities Service
14th and Independence Avenue, SW, Room 4028-S
Washington, DC 20250
Ph: 202-720-2791
Fax: 202-720-2166
Internet: http://www.usda.gov/rus

U.S. DEPARTMENT OF COMMERCE (DOC)
1401 Constitution Avenue, NW
Washington, DC 20230
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Internet: http://www.commerce.gov/

Order Publications From:
National Technical Information Service (NTIS)
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Ph: 703-605-6585
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: http://www.ntis.gov

U.S. DEPARTMENT OF DEFENSE (DOD)
Directorate for Public Inquiry and Analysis
Office of the Secretary of Defense (Public Affairs)
Room 3A750 -- The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-428-0711
E-mail: pia@hq.afis.asd.mil
Internet: http://www.dod.gov

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Springfield, VA 22161
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FAX: 703-605-6900
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### SECTION 01 45 02.00 10

### QUALITY CONTROL SYSTEM (QCS)

04/06

### PART 1 GENERAL

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PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  CONTRACT ADMINISTRATION

1.2.1  Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.2.2  Other Factors

Particular attention is directed to Section 01 33 00, SUBMITTAL PROCEDURES, Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL, and 01 32 16.00 20 CONSTRUCTION PROGRESS DOCUMENTATION which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.3  QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government. Upon specific justification and request by the Contractor, the Government can provide QCS on CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government as they become available.

1.4  SYSTEM REQUIREMENTS

The following is the minimum system configuration that the Contractor shall have to run QCS:

**QCS and QAS System**

**Hardware**

IBM-compatible PC with 1000 MHz Pentium or higher processor
256+ MB RAM for workstation / 512+ MB RAM for server
1 GB hard drive disk space for sole use by the QCS system
Compact Disk (CD) Reader 8x speed or higher
SVGA or higher resolution monitor (1024x768, 256 colors)
Mouse or other pointing device
Windows compatible printer. (Laser printer must have 4 MB+ of RAM)
Connection to the Internet, minimum 56k BPS

Software

MS Windows 2000 or higher
QAS-Word Processing software: MS Word 2000 or newer
Latest version of: Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher
Electronic mail (E-mail) MAPI compatible
Virus protection software that is regularly upgraded with all issued manufacturer's updates

1.5 RELATED INFORMATION

1.5.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.5.2 Contractor Quality Control (CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.6 CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by using the Government's SFTP repository built into QCS import/export function. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.7 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Submit data updates to the Government (e.g., daily reports, submittals, RFI's, schedule updates, payment requests,
etc.) using the tools built into QCS system. If permitted by the Government Representative, e-mail or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically shall include current data on the following items:

1.7.1 Administration

1.7.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, deliver Contractor administrative data in electronic format.

1.7.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A Subcontractor must be listed separately for each trade to be performed. Assign each Subcontractor/trade a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, deliver Subcontractor administrative data in electronic format.

1.7.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.7.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.7.1.6 Request For Information (RFI)

Exchange all Requests For Information (RFI) using the Built-in RFI generator and tracker in QCS.

1.7.2 Finances

1.7.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount,
including modifications. Group pay activities Contract Line Item Number (CLIN); the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.7.2.2 Payment Requests

Prepare all progress payment requests using QCS. Complete the payment request worksheet, prompt payment certification, and payment invoice in QCS. Update the work completed under the contract, measured as percent or as specific quantities, at least monthly. After the update, generate a payment request report using QCS. Submit the payment request, prompt payment certification, and payment invoice with supporting data using the Government's QCS system. If permitted by the Government Representative, e-mail or a CD-ROM may be used. A signed paper copy of the approved payment request is also required, which will govern in the event of discrepancy with the electronic version.

1.7.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements. Maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. Provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Within seven (7) calendar days of Government acceptance, submit a QCS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.7.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Summarize data from any supplemental reports by the Contractor and consolidate onto the QCS-generated Daily CQC Report. Submit daily CQC Reports as required by Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Electronically submit reports to the Government within 24 hours after the date covered by the report. Also provide the Government a signed, printed copy of the daily CQC report.

1.7.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.7.3.3 QC Requirements

Develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in QCS. Update all data on these QC requirements as work...
progresses, and promptly provide this information to the Government via QCS.

1.7.3.4 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.7.3.5 Labor and Equipment Hours

Log labor and equipment exposure hours on a daily basis. This data will be rolled up into a monthly exposure report.

1.7.3.6 Accident/Safety Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. Regularly update the correction status of the safety comments. In addition, utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., and OSHA Form 300.

1.7.3.7 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.7.3.8 Hazard Analysis

Use QCS to develop a hazard analysis for each feature of work included in the CQC Plan. The hazard analysis shall address any hazards, or potential hazards, that may be associated with the work.

1.7.4 Submittal Management

The Government will provide the initial submittal register in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. Submittal transmittal form, and the submittal register update shall be produced using QCS. QCS and RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.7.5 Schedule

Develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts" and Section 01 32 16.00 20, CONSTRUCTION PROGRESS DOCUMENTATION. This schedule shall be input and maintained in the QCS database either manually or by using the system tools). The updated schedule data shall be included with each pay request submitted by the Contractor.
1.7.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data from system.

1.8 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.9 DATA SUBMISSION VIA CD-ROM

The Government-preferred method for Contractor's submission of QCS data is by using the Government's QCS system. Other data should be submitted using E-mail with file attachment(s). For locations where this is not feasible, the Government Representative may permit use of CD-ROM for data transfer. Export data onto CDs using the QCS built-in export function. If used, submit CD-ROMs in accordance with the following:

1.9.1 File Medium

Submit required data on CD-ROM. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.9.2 CD-ROM Labels

Affix a permanent exterior label to each CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.9.3 File Names

The files will be automatically named by the QCS software. The naming convention established by the QCS software shall not be altered in any way by the Contractor.

1.10 MONTHLY COORDINATION MEETING

Update the QCS database each workday. At least monthly, generate and submit an export file to the Government with schedule update and progress payment request.

Make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.11 NOTIFICATION OF NONCOMPLIANCE

The Government Representative will notify the Contractor of any detected noncompliance with the requirements of this specification. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification.
PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --
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04/06

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PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D3740 (2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction


1.3 ELECTRONIC TEST REPORT DATA

As part of the Contractor's Quality Control Program, electronic transmission of test report data in the prescribed formats in addition to the original test report data shall be furnished to the Government. The Technical Specification sections include testing and/or frequency requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with Section 00700 Standard General Conditions, Article 6. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent and Quality Control Manager will be held responsible for the quality of work on the job and is subject to removal by the Government Representative for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction
activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Government Representative, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 15 days after receipt of notice of award, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of Section 00700 Standard General Conditions. The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started. A sample CQC Plan is attached at the end of the section.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Government Representative shall be used.)
f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his/her CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Government Representative in writing of any proposed change. Proposed changes are subject to acceptance by the Government Representative.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Government Representative or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 calendar days prior to the Coordination Meeting. During the Coordination Meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Government Representative. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.
3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The CQC System Manager shall be a Louisiana licensed Professional Engineer. The Safety and Health Manager shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Government Representative. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Government Representative.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a construction person with a minimum of five (5) years experience in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned as System Manager. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Government Representative for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01 33 00 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three (3) phases of control shall be conducted by the CQC System Manager for each definable feature of the construction work as follows:
3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications


c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Government Representative.

j. Discussion of the initial control phase.

k. The Government Quality Assurance personnel shall be notified at least 48 hours in advance of beginning the preparatory control phase. The Contractor shall submit a written agenda of the topics to be discussed at the preparatory meeting on the day prior to the meeting date. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), Government Quality Assurance personnel, and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. The Contractor shall notify the Government's Representative at least 24 hours prior to all quality control testing in order to coordinate simultaneous quality assurance tests if the Government Representative elects to do so. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Government approved testing laboratory or establish an approved testing laboratory at the project site. Depending upon the workload by the
Government inspecting agency, acceptance or rejection of the Contractor proposed testing laboratory is usually done approximately 60 to 120 days after notification is received from the Contractor. The certification will be valid for two (2) years. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Government Representative, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Government Representative. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

f. Field soil sampling and testing locations shall be recorded using GPS coordinates accurate to the meter range.

g. An informational electronic copy (PDF file of actual test result) of all material tests performed (regardless of whether performed by an offsite test facility or an on-site test facility) shall be electronically transmitted to a Government within 24 hours of test report completion. An electronic data entry form (Excel based) will be provided by the Government to enter electronic data, in a format prescribed by the Government. This data file shall contain the results of the required material tests. The Government will provide the required template for data transmission at the CQC Plan Coordination Meeting.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D3740 and ASTM E329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $3500.00 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently
3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to Government approved laboratory.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the Section 00700 Standard General Conditions or stated elsewhere in the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph "DOCUMENTATION". The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the work is complete. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Government Representative shall be in attendance at this inspection. The final acceptance inspection will be formally scheduled by the Government Representative based upon results of the Pre-Final inspection. Notice shall be given to the Government Representative at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all
3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 12 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven (7) days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control representatives.
control personnel.

3.10 SAMPLE FORMS

Sample forms for guidance in preparing the CQC Plan are enclosed at the end of this section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Government Representative will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Government Representative may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --
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PART 1   GENERAL

1.1  SCOPE

This work shall consist of designing, furnishing, installing, maintaining and subsequently removing all temporary retaining structures required to complete this project. The Contractor shall be solely responsible for the design, layout, construction, maintenance and subsequent removal and disposal of all elements of the temporary retaining structures.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

PILE BUCK INTERNATIONAL, INC. (PBI)


U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1  (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

U.S. STEEL CORPORATION (USS)

USS-01  (1972) Steel Sheet Piling Design Manual

VIRGINIA POLYTECHNIC UNIVERSITY, DEPT. OF CIVIL ENGINEERING (VT)


1.4  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

A detailed layout of temporary retaining structures on standard
size (28 inches x 40 inches) sheets. These shop drawings shall bear the stamp and signature of the Louisiana Registered Professional Engineer. These drawings shall clearly show:

(a) All pertinent dimensions and locations of these structures with reference to the project centerline (Wall-line, Baseline, etc.).

(b) Material grade, weight, length and designation of steel sheet pile section(s) used.

(c) Bracing details.

(d) Excavation sequence and procedure.

(e) Provisions made for dewatering, indicating stage of excavation vs. necessary drawdown, water loading conditions, soil loads and equipment loads.

(f) Any other items incidental or significant to this work.

(g) Equipment Description. Complete hammer, extractors and other installation appurtenances.

SD-05 Design Data

Design Calculations; G

Provide design calculations used to develop the retaining structure plan. Calculations shall be stamped and signed by the Louisiana Registered Professional Engineer with at least five (5) years of documented experience in the design of retaining structures.

1.5 DESIGN CALCULATIONS

1.5.1 Design Procedures

The Contractor shall follow design procedures using the wedge-type method of developing soil pressure for estimating the external forces, set forth in USS-01 excluding the Danish Rules Method published by U.S. Steel Corp.; the PBI-01; or the Free Earth or Fixed Earth methods in the Virginia Tech Dept. of Civil Engineering paper VT-01; or Chapter 4 of the U.S. Army Corps of Engineers Manual EM 1110-2-2504 "Design of Sheet Pile Walls", excluding the Danish Rules Method. Determination of the effects of surcharge loads on the soil pressures shall be based on the procedures set forth in PBI-01. The design performed by the Contractor must evaluate the overall stability and sizing of the sheet piling and other structural elements for the temporary retaining structures. The Contractor shall submit for approval shop drawings of the proposed design. The Contractor shall use and rely upon the soil borings, design shear strength profile(s) and unit weight data presented in the plans and/or in the figure(s) attached at the end of this section for its design. The structure shall meet all the requirements of EM 385-1-1 for fall protection and ingress and egress.

1.5.2 Elevations

The resulting temporary retaining structure shall have sufficient height
to facilitate permanent construction and have a minimum sheet pile tip elevation -35.0 feet. The sheet pile tip elevation specified herein is that required for cut-off of recharge of strata having excess hydrostatic water levels. As a minimum this tip elevation shall be provided regardless of that computed in overturning computation.

1.5.3 Sheet Pile Wall Design

The design of the sheet pile wall shall be developed using a method of analysis indicated in paragraph "Design Procedures," with the safety factor applied to the soil strengths on both sides of the wall, such as a free earth or fixed earth method. The soil properties used shall be those presented in the drawings and/or in the figure(s) attached at the end of this section.

1.5.3.1 Loads

The minimum safety factor used in the geotechnical design for the determination of overturning tip elevation and sheet pile section modulus is 1.30 in the short term (Q) case analysis and 1.0 for the long term (S) shear strength cases. For design of the sheet pile wall the water conditions outside the excavation shall be +12.0 feet, while the water inside the temporary retaining structure excavation is in the drawn-down condition. The design shall also include the loading influence of any equipment that may be operated adjacent to the temporary retaining structure. If the designer elects to account for wall friction and adhesion in the determination of soil pressures, the following criteria shall be used:

1. a maximum value of 54% of the "allowable" soil friction angle in granular materials may be used for wall friction,
2. a maximum value of 56% of the "allowable" soil cohesion may be used for adhesion and
3. no wall friction or adhesion may be applied to the soils above the dredge line.

1.5.3.2 Design of Anchors and Deadmen

In the design of anchors and deadmen the designer shall develop a minimum safety factor of 2.0 for the soil resistance against pull out.

1.5.3.3 Retaining Wall Members

The structural design of the temporary retaining structure excluding the sheet pile shall be designed using industry standards. The earth pressures for the structural design of these wall members shall be based upon a wedge-type method applying a safety factor chosen by the designer which shall be no lower than 1.0.

1.5.3.4 Arch Web "U" Piles

If arch web "U" piles are used, then the design shall account for and include calculations for shear transfer across their interlocks. Arch web piles or piles with interlocks at or near their center of gravity tend to slip under loading when the shear transfer cannot be achieved across their interlocks. Arch web piles shall be designed in accordance with the recommendations set forth in the standard CUR 166 published in 1993 in
Holland by the Center for Execution, Investigations and Standardization in Civil Engineering (CUR) ('Dammwandconstructies' Civieltechnisch Centrum Uitvoering Research en Regelgeving, Holland, available from New Orleans District, Corps of Engineers, ED-T). Anti-slipping connections such as welding or crimping of the interlocks can be employed to help prevent displacements of the interlocks. The design calculations shall include all assumptions and shall consider the type(s) of soil, the effects of water, type of wall (i.e. cantilevered versus braced and shall include the location and number of wales, struts, etc), whether the piles are driven singly, in pairs, triple, etc., effects of phased excavation, treatment of the interlocks (i.e. how shear transfer is accomplished through welding or crimping), references cited, and any other considerations.

1.5.3.5 Designs and Modifications

All designs and any subsequent modifications to the design presented above shall be performed, certified and stamped by a Registered Professional Engineer and submitted to the Government Representative for review and approval. The Registered Professional Engineer shall be present at the Contractor Quality Control preparatory and initial inspections. The Contractor shall, as a part of the Quality Control, furnish a signed statement by the design Professional Engineer stating that the installation is in conformance with the approved design.

1.5.3.6 Engineering Analysis and Calculations

If the Contractor's construction plan, sequence and/or methods require the use of the existing structures or levees for any purpose, he shall perform engineering analysis and calculations to ascertain that the purpose for which he intends to use the existing structure will not jeopardize the structural integrity of the same or any part, component, or portion thereof. Any damages, direct or indirect, caused to that property and to the property of others due to Contractor's failure to comply with this requirement or negligence in calculations shall be the sole responsibility of the Contractor.

1.6 QUALITY CONTROL

1.6.1 General

The Contractor shall establish and maintain quality control for all operations to assure compliance with contract specifications and maintain records of its quality control for all construction operations, including but not limited to the following:

(1) Designing.
(2) Materials (type, strength, etc.).
(3) Fabrication, installation and workmanship.
(4) Full and proper engagement of interlock (inspection and strength).
(5) Placing (location, alignment, etc.).
(6) Driving (pile hammer and rate of operation).
(7) Cutting.
(8) Welding.

(9) Final sheet pile position; depth of penetration; tip and top elevations.

(10) Stockpiling and Storage.

(11) Removal and disposal of damaged piles.

1.6.2 Reporting

The original and two (2) copies of these records and tests, as well as the corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.7 DELIVERY, STORAGE AND HANDLING OF MATERIALS

Materials delivered to the site shall be undamaged and shall be accompanied by certified test reports. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate inspection.

PART 2 PRODUCTS

2.1 SHEET PILING

The sheet pile shall be hot rolled sheet pile.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Placing

Suitable temporary wales, templates, guide structures, or other approved methods shall be provided to insure that the piles are placed and driven to the correct alignment as shown on the Contractor's shop drawings. Piles shall be placed with each pile interlocked with adjoining piles for its entire length, so as to form a continuous diaphragm throughout the length of each run of piling wall. Interlocks shall be properly engaged. The Contractor's personnel shall not sit or place themselves on top of the sheet piling during the handling, installation, and removal of the piling.

3.1.2 Driving

All sheet piles shall be driven to the depths shown on the Contractor's shop drawings. Pilings shall be driven by approved methods so as not to subject the pilings to damage and to insure proper interlocking throughout their lengths. Pilings damaged during driving or driven out of interlock shall be removed and replaced. All piles shall be driven without the aid of a water jet, unless otherwise authorized. Unless specifically indicated otherwise, each run of piling wall shall be driven to grade progressively from the start and pilings in each run shall be driven alternately in increments of depth to the required depth or elevation. On each day of sheet pile driving, the Contractor shall stab only the number of piles that can be driven to grade by the end of the day, and all piling stabbed shall be driven to grade by the end of each working day except
that the last two piles may remain tapered up to receive the next days piles. If the piling next to the one being driven tends to follow below final grade, it may be pinned to the next adjacent piling. The Contractor is advised that buried stumps or similar debris may be encountered periodically on the sheet pile wall alignment and appropriate consideration should be given to hard driving conditions should they occur. Piles shall not be driven within 100-feet of concrete less than 7 days old nor within 30-feet of concrete less than 28 days old.

3.1.3 Emergency Locking System on Pile Driving Head

All pile driving equipment shall be equipped so as to prevent piles from falling when a single or multiple power failure occurs after the pile driving head is attached to the pile. The jaws of vibratory hammers shall be equipped with devices such that upon loss of hydraulic pressure, the jaws will not release the pile.

3.1.4 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be damaged or driven out of interlock shall be removed and replaced.

3.1.5 Void Backfill

Where voids adjacent to the steel sheet piling are induced by pile driving operations, the Contractor shall pump out all seepage and rain water and backfill with a tremie-placed slurry. The slurry shall consist of one part cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids.

3.2 REMOVAL OF MATERIAL

3.2.1 Removal Criteria

The temporary retaining structures shall not be removed until suitable backfill, between the finished structure and the steel sheet pile wall of the temporary retaining structures is satisfactorily placed and compacted to an elevation approximately one (1) foot below the finished surface. Piles shall not be pulled within 100-feet of concrete less than 7 days old nor within 30-feet of concrete less than 28 days old. Nor, shall the temporary retaining structures be removed until the completed permanent structure and/or excavations are rewatered. Where voids are induced by removal operations, the Contractor shall pump out all seepage and rainwater and backfill to within 3 feet of the ground surface with a tremie-placed slurry. The slurry shall consist of one part cement, two parts bentonite and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids but have no less than 12 pounds of solids per gallon. The upper 3 feet shall be filled with suitable backfill. Suitable backfill and compaction requirements shall be as defined in Section 31 23 16.16 12 STRUCTURAL EXCAVATION AND BACKFILL. All Contractor-furnished temporary retaining structures shall be removed from the site of work upon completion of work.

3.2.2 Safety

The removal of the temporary retaining structures shall be accomplished in a manner not injurious to the properties adjacent to and in the proximity of the project excavations.
-- End of Section --
PART 1 GENERAL

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3.9 PERMIT
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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of providing a Traffic Control Devices Plan (TCDP) designed by a Louisiana Registered Professional Engineer, furnishing all equipment, materials and labor required to implement the TCDP and maintaining the safe and expeditious movement of traffic during construction in accordance with these specifications. This includes providing, installing, inspecting and maintaining, signs, barricades, flashing-arrow panels, lights, temporary barriers, flagmen and police details as deemed necessary by the Government Representative.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)


LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES (2006 Edition), LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT (LADOTD)

LSSRB 713 Temporary Signs, Barricades and Pavement Markings

1.4 DEFINITIONS

The Louisiana Department of Transportation and Development (LADOTD) is the approving agency for all TCDPs on I-10, LA 44 (River Road), US 61 (Airline Hwy), and all other State-maintained roadways.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Traffic Control Device Plan

The Contractor shall have a Louisiana licensed professional engineer prepare and submit the original and ten (10) copies of the Traffic Control Device Plan as specified herein, to LADOTD for review and approval and permitting for those roadways on the State system. Such approval is required prior to the start of any work which might affect local traffic patterns. The TCDP shall be schematically drawn on sheet(s) large enough to show traffic engineering devices with adequate details and be easily readable and reproducible.

Adequate time (a minimum of 45 calendar days exclusive of mailing time) shall be allowed for review and approval. Such approval is required prior to start of any work which might affect the traffic pattern.

SD-02 Shop Drawings

Shop Drawings

The Contractor shall submit shop drawings detailing the individual road signs/traffic control signs (Traffic Control Devices) to be used on this project.

PART 2 PRODUCTS

2.1 SIGNS AND BARRICADES

In accordance with LSSRB 713, the Contractor shall provide all necessary signs, barricades, temporary pavement markings, in accordance with the Louisiana Manual on Uniform Traffic Control Devices, Construction Section as well as all signs, barricades, blinking lights or other necessary traffic control devices required by the Louisiana Department of Transportation and Development (LADOTD) or other governing specifications. Power for lighted sign should be provided by non-fossil fuel type equipment and muffled or isolated to prevent noise nuisance.

PART 3 EXECUTION

3.1 GENERAL

No signs or signals shall be removed without the Government Representative's and the LADOTD Traffic Engineer's approval. The Contractor accepts all responsibilities during the time of removal. The Contractor will notify the Government Representative and LADOTD Traffic Engineering Department in writing within three (3) working days prior to the controls being removed and reinstalled.

3.2 TRAFFIC CONTROL DEVICE PLAN

The Contractor shall develop and implement a site specific Traffic Control Device Plan (TCDP) and truck haul route plan which shall provide for the safe and expeditious movement of traffic through construction zones. A construction zone is defined as the immediate area of actual construction which interferes with the driving or walking public. The TCDP shall comply with the requirements set forth in the MUTCD, and with the general requirements stipulated below.
(1) The TCDP for the site shall address the conditions for providing traffic flow and/or detours within the zone during the influence of construction. The TCDP shall be schematically drawn on sheet(s) large enough to show adequate details and be easily readable and reproducible. If larger than eleven inches by seventeen inches (11" x 17"), the sheet(s) shall be submitted with a digital copy provided on a DVD so that the Government Representative and the LADOTD Traffic Department can produce additional copies as needed.

(2) The TCDP shall be designed and stamped by a Professional Engineer registered in the State of Louisiana. The qualifications of the Engineer shall be submitted for review and approval of the Government Representative, and where applicable LADOTD Traffic Operations. Engineers for this project will be qualified by education and experience in Categories 1 and 2 as noted below. All categories require a minimum of four (4) years experience and education.


b. Category 2 - Permanent Sign / Marking. Urban experience in MUTCD applications, studies in volume, speed, pedestrians, and accident analysis.

3.3 TRAFFIC CONTROL

The Contractor shall submit shop drawings detailing the individual road designs/individual traffic control signs and be responsible for the installation and maintenance of all devices and requirements for the duration of the construction period. The necessary precautions shall include, but not be limited to, such items as proper construction warning signs, signals, lighting devices, battery operated flashers, markings, barricades, channelization, and hand signaling devices (flagging operations). The Contractor shall monitor traffic control devices on a daily basis and shall make appropriate changes to correspond to conditions. All work shall be performed in accordance with the LSSRB 713, except as noted. Traffic control devices shall be in accordance with the MUTCD.

3.3.1 Coordination

The Contractor shall consult with the Government Representative and the LADOTD Traffic Engineering Division immediately on any vehicular or pedestrian safety or efficiency problem incurred as a result of construction of the project.

3.3.2 Traffic Engineer

A Louisiana licensed Traffic Engineer shall be provided by the Contractor to inspect the job site at the beginning of the project, after significant changes, and at 30 day intervals. If warranted, the Contractor's Traffic Engineer shall make adjustments to the TCDP and the Contractor shall immediately implement the revised TCDP. A written report submitted to the Contractor, the Government Representative and the LADOTD Traffic Engineering Division verifying compliance with the plan and adequacy of traffic control devices and operating conditions will be required for each inspection. All deficiencies noted by the report shall be immediately
corrected by the Contractor.

3.4 PUBLIC CONVENIENCE AND SAFETY

3.4.1 Road Closure

No road shall be closed by the Contractor to the public except by written permission of the Government Representative, and except while so closed, the Contractor shall maintain traffic over, through, or around the work included in his Contract, with the maximum practical convenience, for the full twenty-four hours of each day of the Contract, whether or not work has ceased temporarily. The Contractor shall notify the Government Representative at the earliest possible date after the Contract has been executed, and in any case before the starting of any construction that might in any way inconvenience or endanger traffic, so that the necessary arrangements may be determined.

3.4.2 Fire Protection

Fire hydrants shall be accessible at all times to the Fire Department. No material or other obstructions shall be placed closer to a fire hydrant than permitted by ordinances, rules, or regulations or within 15 feet of a fire hydrant, in the absence of such ordinances, rules, or regulations.

3.5 BARRICADES, DANGER, WARNING, AND DETOUR SIGNS

3.5.1 General

The Contractor shall, at his own expense, provide, erect, paint, and maintain all construction barricades. The Contractor shall provide suitable and sufficient lights, torches, reflectors, or other danger signals and signs, provide a sufficient number of watchmen and flagmen, and take all necessary precautions for the protection of the work and safety of the public. The Contractor shall replace any permanent street signs or markers which have to be moved to facilitate his construction with temporary signs as necessary.

3.5.2 Warning Signs, Painting, Illumination

The Contractor shall erect warning signs beyond the limits of the project, sufficiently in advance of any place on the project where operations interfere with the use of the road by traffic, including all intermediate points where the new work crosses or coincides with the existing road. Barricades shall be kept well painted and suitable warning signs shall be placed thereon. All barricades and obstructions shall be illuminated at night and all lights or devices for this purpose shall be kept burning from sunset to sunrise.

3.6 EMERGENCY CONTRACTOR DESIGNATION

The Contractor shall designate a person(s) who can be contacted and shall be available on a seven (7) day week, 24 hour basis through the entire period that the contract is in force. Name(s) and telephone number(s) of the individual(s) designated shall be furnished to the Government Representative prior to starting work. The person contacted shall be able to respond to emergencies occurring along the length of the project during normal after work and holiday hours.
3.7 ROAD SIGNS

Existing road signs within the limits of work, as shown on the Contractor's access plans, shall be removed prior to construction, shall be stored during construction, and returned to their original location after construction is complete.

3.8 CONTACTS

The Contractor shall give 48 hours advance notification to the Sheriff, fire department, school board, and other affected parish departments, and the general public of the necessity to close any portion of roadway. The Contractor shall request final approval of such closings from the Government Representative at least 48 hours in advance.

<table>
<thead>
<tr>
<th>Contact Name</th>
<th>Phone #</th>
</tr>
</thead>
<tbody>
<tr>
<td>LADOTD</td>
<td>Steven Strength (504)437-3105</td>
</tr>
</tbody>
</table>

3.9 PERMIT

The Contractor shall obtain all required permits from said government agencies, namely LADOTD and St. John The Baptist Parish, for construction operations necessary for fulfillment of this contract.

3.10 ROAD CLOSURE

No road shall be closed by the Contractor to the public without prior approval of the LADOTD and Parish. The Contractor shall maintain traffic over, through, or around the work included in the contract, with a maximum practical convenience, for the full 24 hours of each day of the contract period, whether or not work has ceased temporarily. The Contractor shall notify the Government Representative at the earliest possible date after the Notice to Proceed, and in any case before the starting of any construction that might in any way inconvenience or endanger traffic, so that the necessary arrangements may be determined.

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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all labor, materials and equipment, and performing all work required for the prevention of environmental pollution and the handling, removal, transportation and disposal of any hazardous and/or regulated solid waste generated during and as the result of construction operations under this contract except for those measures set forth in other provisions of these specifications. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to man; or degrade the utility of the environment for esthetic and recreational purposes. The control of environmental pollution requires consideration of air, water, and land, and involves noise, solid waste-management, management of radiant energy and radioactive materials, as well as other pollutants including hazardous wastes, materials, substances and chemicals.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 APPLICABLE REGULATIONS

In order to prevent, and to provide for abatement and control of any environmental pollution arising from construction activities in the performance of this contract, the Contractor and his subcontractors shall comply with the Louisiana Pollution Discharge Elimination System (LPDES) General Permit requirements as specified in Section 01 57 23.00 12 STORM WATER POLLUTION PREVENTION MEASURES, all applicable Federal, State, and Local laws, and regulations as well as Government regulations concerning environmental pollution control and abatement and any regulations referred to in the following paragraphs. For hazardous wastes, materials, substances and chemicals applicable regulations shall include, but are not limited to, 29 CFR 1910.106, 29 CFR 1910.120, 40 CFR 260, 40 CFR 279, 40 CFR 355, 40 CFR 372-SUBPART D, 49 CFR 171 - 178 and EM 385-1-1, LAC 33:V, and LAC 33:VII.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

LOUISIANA ADMINISTRATIVE CODE (LAC)

LAC 33:V Environmental Quality: Hazardous Waste and Hazardous Materials
1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Pollution Control Plan; G

Environmental Protection Plan; G

1.6 QUALITY CONTROL

1.6.1 General

The Contractor shall establish and maintain quality control for environment protection to assure compliance with contract specifications and maintain records of his/her quality control for all construction
operations including but not limited to the following:

(1) Submit plan of Environmental Pollution Control Plan/Environmental Protection Plan. For Contractor work activities (such as painting, metal finishing, etc.) that will involve bringing hazardous chemicals, hazardous substances or hazardous materials onto the project site, include in the plan a Hazard Communication Program and Safe Storage Plan. For Contractor activities that anticipate generation of hazardous wastes at the project site, include in the plan a waste identification / determination and waste disposal plan. For Contractor on-site activities that pose a risk of an oil or hazardous substance spill, include in the plan a Spill Reporting and Response Plan.

(2) Procure applicable Federal, State, and Local regulations on pollution control.

(3) Air Pollution - Checks made on dust, smoke, and noise.

(4) Water Pollution - Checks made on disposal of water, oil, etc.

(5) Land Pollution - Checks made on disposal of debris, restoration of temporary construction sites, etc.

(6) Training Course for Employees.

1.6.2 Reporting

The original and two (2) copies of these records, as well as the records of corrective action taken, shall be furnished the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.7 NOTIFICATION

The Government Representative will notify the Contractor in writing of any non-compliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his/her authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Government Representative may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due to any such stop orders the subject of a claim for extension of time or for excess cost of damages.

1.8 SUBCONTRACTORS

Compliance with the provisions of this section by subcontractors will be the responsibility of the Contractor.

1.9 IMPLEMENTATION

Within ten (10) days after receipt of Notice of Award, or otherwise directed below, the Contractor shall:

(1) Submit in writing his/her proposals for implementing environmental pollution control at the project site, disposal of debris, non-hazardous wastes and hazardous wastes generated at the
project site as well as storage and management of regulated materials, substances and chemicals brought onto and used at the project site.

(2) Meet with representatives of the Government Representative to develop mutual understanding relative to compliance with this provision and administration of the environmental pollution control program.

(3) If applicable, submit a plan for the identification, handling, removal, transportation and disposal of hazardous and/or regulated solid wastes generated because of the Contractor's operation.

1.9.1 Environmental Assessment of Contract Deviations

The Contractor is advised that deviations from the drawings or specifications (e.g., proposed alternate borrow areas, disposal areas, staging areas, alternate access routes, etc.) could result in the requirement for the Government to reanalyze the project from an environmental standpoint. Deviations from the construction methods and procedures indicated by the plans and specifications, which may have an environmental impact will require an extended review, processing, and approval time by the Government. The Government Representative reserves the right to disapprove alternate methods, even if they are more cost effective, if the Government Representative determines that the proposed alternate method will have an adverse environmental impact.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PROTECTION OF LAND RESOURCES

3.1.1 General

The land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction that will appear to be natural and not detract from the appearance of the project. The Contractor shall confine his/her construction activities to areas defined by the plans or specifications, including borrow areas to be cleared. The following additional requirements are intended to supplement and clarify the requirements of Section 00700 Standard General Conditions.

3.1.2 Prevention of Landscape Defacement

Except in areas to be cleared and as provided in paragraph "Temporary Excavation and Embankments", the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without the approval of the Government Representative. Felling of trees shall be performed in such a manner as to avoid damage to trees to be left standing. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's operations or equipment; he shall protect adequately such trees. Earth that is displaced into uncleared areas shall be removed. All monuments and markers shall be protected before beginning operations near them. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. Trees that are scarred shall be immediately painted with an acceptable tree wound.
paint. Any trees that are damaged beyond restoration shall be removed and disposed of as directed in paragraph "DISPOSAL OF NON-REGULATED DEBRIS".

3.1.3 Temporary Excavation and Embankments

If the Contractor proposes to construct temporary roads or embankments and excavation for plant and/or work areas, he shall obtain approval of the Government Representative prior to start of such temporary work.

3.1.4 Post-Construction Cleanup or Obliteration

The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, and stockpiles of excess or waste materials upon completion of construction. The Contractor will be required to restore the construction area to near natural conditions that will permit the growth of vegetation.

3.1.5 Recording and Preserving Historical and Archeological Finds

When an item having apparent historical or archeological interest is discovered in the course of any construction activities, then no work will proceed in the area containing the cultural resources until a Government Representative has been notified and final coordination with the State Historic Preservation officer has been completed. The Contractor shall leave the archeological find undisturbed and shall immediately report the find to the Government Representative so that the proper authorities may be notified.

3.2 PROTECTION OF WATER RESOURCES

3.2.1 Contamination of Water

The Contractor shall not pollute lakes, ditches, rivers, bayous, canals, groundwater, waterways, or reservoirs with fuels, oils, bitumens, calcium chloride, insecticides, herbicides, or other similar materials harmful to fish, shellfish, or wildlife, or materials which may be a detriment to outdoor recreation.

3.2.2 Disposal of Materials

The methods and locations of disposal of materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., within the right-of-way limits shall be such that harmful debris will not enter lakes, ditches, rivers, bayous, canals, groundwater, waterways, or reservoirs by erosion, and thus prevent the use of the area for recreation or present a hazard to wildlife.

3.2.3 Erosion Control

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be held in suitable sedimentation ponds or shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures as specified in Section 01 57 23.00 12 STORM WATER POLLUTION PREVENTION MEASURES, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operative. The area of bare soil exposed at any one time by construction operations shall not exceed
that necessary to perform the work. Stream crossings by fording with equipment shall be limited to control turbidity and in areas of frequent crossings temporary culverts or bridges shall be installed. Any temporary culverts or bridges shall be removed upon completion of the project. Fills and waste area shall be constructed by selective placement to eliminate silts or clays on the surface that will erode and contaminate adjacent streams.

3.3 PROTECTION OF FISH AND WILDLIFE

The Contractor shall at all times perform all work and take such steps required to prevent any interference of disturbance to fish and wildlife. The Contractor will not be permitted to alter water flows or otherwise disturb native habitat adjacent to the project area that are critical to fish or wildlife.

3.3.1 Colonial Nesting Birds

3.3.1.1 General

Colonial nesting wading birds (including, but not limited to, herons, egrets and ibis), seabirds/waterbirds (including, but not limited to, terns, gulls, Black Skimmers and Brown Pelicans) and bald eagles are known to nest in the project area. The nesting birds and their nests must not be disturbed or destroyed. The nesting activity period extends from 15 February through 1 September for colonial nesting wading and seabirds/waterbirds, and September to May for bald eagles. However, birds could arrive earlier than February 15, as such nesting prevention measures should be taken year-round for areas identified as annual nesting sites. The CEMVN PM-R can provide additional information on the known nesting sites in the project area.

3.3.1.2 Reporting

The presence of nesting wading birds and/or seabirds/waterbirds within the minimum distances from the work area, as specified in paragraph "No Work Distances", shall be immediately reported to the Government Representative who will then contact the appropriate authority.

3.3.1.3 No Work Distances

No Work distance restrictions are as follows:

- Terns, gulls, and Black Skimmers - 650 feet;
- Colonial nesting wading birds - 1,000 feet;
- Brown Pelicans - 2,000 feet; and
- Bald Eagles - 1,000 feet.

3.3.1.4 Bird Nesting Prevention and Avoidance Measures

The Contractor shall prepare and submit to the Government Representative, for approval, a plan detailing the efforts that will be undertaken to prevent birds from nesting within the minimum distances, as specified in paragraph "No Work Distances", from any work activity. Nest prevention measures shall be intended to deter birds from nesting within 1,000 feet of construction areas without physically harming birds during the nesting activity period, as specified in paragraph "General". Nest prevention measures may be used in combination and/or adjusted to be most effective. The use of any harassment measures shall be in accordance with EM 385-1-1.
The Contractor shall employ U.S. Fish and Wildlife Service (USFWS) approved nesting prevention measures that might include, but are not limited to: auditory record construction noises, air canons, olfactory-pheromones, optical - silver and orange streamers, tree netting - stealth nets, constructing a frame for net streamers so that the birds could see the net, manual scare tactics-hitting the tree, taking nests without eggs apart, relocating constructed nests without eggs/chicks, continual presence around certain "preferred trees".

Specific nest prevention measures used during the work shall be monitored for effectiveness and may require adjustment and/or modification. All equipment/supplies used for nest prevention shall be removed from the work site upon the completion of work and as directed by the Government Representative.

3.3.1.5 Discovery of Bird Nests at the Work Site

If bird nests are discovered at the work site, immediate notification shall be made in accordance with paragraph "Reporting". Contractor shall immediately mark the bird nests with flagging on stakes three (3) feet above the ground surface and no closer than three (3) feet from the nest. The Contractor shall immediately implement safe work distances from the nest(s) as specified in paragraph "No Work Distances", place flagging to create exclusion zone(s) around the nest(s), and advise all equipment operators of the bird nest(s) and exclusion zone(s). If, by order of the USFWS or the Government Representative, work must stop in a particular area due to nesting birds, an adjustment to the schedule shall be made in accordance with Section 00700, Standard General Conditions.

3.4 JANITOR SERVICES

The Contractor shall furnish daily janitorial services for all the offices, shops, laboratories, or other buildings being used by the Contractor or Government employees, whether existing or Contractor furnished, and perform any required maintenance of the facilities and grounds during the life of the contract. Toilet facilities shall be kept clean and sanitary at all times. Services shall be performed at such a time and in such a manner to least interfere with the operations but will be accomplished only when the buildings are in daily use. Services shall be accomplished to the satisfaction of the Government Representative. The Contractor shall also provide daily trash collection and cleanup of the buildings and adjacent outside areas, snow removal as required, and shall dispose of all discarded debris, aggregate samples and concrete test samples in a manner approved by the Government Representative.

3.5 DISPOSAL OF NON-REGULATED DEBRIS

All debris resulting from construction operations on this contract shall be disposed of in accordance with local, state, and federal regulations.

3.6 DISPOSAL OF HAZARDOUS AND/OR REGULATED SOLID WASTES

If any hazardous or regulated solid wastes will be generated as a result of the Contractor's operations, the Contractor shall submit a plan that details the proper handling, removal, transportation and disposal of such wastes. The plan shall identify what types of hazardous and/or regulated solid wastes will be generated and shall list the hazards involved with
each waste. All waste generated on-site by the Contractor must be properly identified within 30 days of generation. No regulated wastes shall be allowed to accumulate on-site for more than 90 days. Regulated solid wastes are those listed in the LAC 33:VII. The plan shall include Material Safety Data Sheets (MSDS), if applicable, for all wastes expected to be generated. The plan shall include, but not be limited to the following:

(a) Hazardous waste shall be placed in closed containers and shall be shielded adequately to prevent dispersion of the waste by wind or water. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken.

(b) Nonhazardous waste shall be stored in containers separate from hazardous waste storage areas.

(c) All hazardous waste shall be transported by a licensed transporter in accordance with LAC 33:V and 49 CFR 171, Subchapter C.

(d) All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation.

(e) In addition to the number of manifest copies required by LAC 33:V, one copy of each manifest will be supplied to the Government Representative prior to transportation.

(f) The plan shall identify what types of hazardous and/or regulated solid wastes will be generated and shall list the hazards involved with each waste.

3.6.1 Hazardous Wastes

For the handling, removal, transportation and disposal of any generated hazardous wastes, the plan shall conform to the requirements of 40 CFR 260, 49 CFR 171 - 178 as well as other applicable Federal, State and Local regulations. All employees of the Contractor of his/her Subcontractors that will be directly involved in the handling and/or removal of hazardous wastes shall be trained in accordance with 29 CFR 1910.120. In addition, the employees shall have undergone a medical evaluation in accordance with 29 CFR 1910.120. The Contractor shall include copies of employees' certifications and medical examinations as part of the plan specified herein. The plan shall also address the proper Personnel Protective Equipment (PPE) that the employees will be required to wear during the handling and removal of hazardous wastes. The Contractor shall obtain an EPA ID# and Hazardous Waste Disposal Manifests and shall sign the manifests as the generator. Wastes shall be transported via state and Federal approved hazardous waste transporter and disposed of at a state and Federal approved temporary, storage and disposal (TSD) facility. Copies of licenses and certifications of the transporter and TSD shall be included in the plan. The plan shall list the name and address of each transporter and TSD to be utilized. The Contractor shall be responsible for any sampling and analysis required by the TSD for characterization purposes. The Contractor shall submit to the Government Representative completed copies of all Hazardous Waste Disposal Manifests within five (5) days after ultimate disposal at the TSD. Other regulations applicable to the handling, removal, transportation and disposal of hazardous wastes are: 40 CFR 261; 40 CFR 262; 40 CFR 268; and LAC 33:V.
3.6.2 Regulated Solid Wastes

For the handling, removal, transportation and disposal of any generated regulated solid wastes, the plan shall conform to the requirements of LAC 33:VII. Solid wastes shall be transported to a Federal and state approved TSD, oil recycling program or Industrial Type I Landfill. The Contractor shall identify in the plan how he/she intends to dispose of each solid waste. The plan shall include the name, address, licenses and certifications of each disposal facility that will be used. If disposal manifests are required, the Contractor shall sign them as the generator. The Contractor shall be responsible for any sampling and analyses that may be required by the disposal facility(ies) for characterization purposes. Licenses and certifications of the transporter and disposal facilities shall be included in the plan. The Contractor shall submit to the Government Representative a completed copy of any waste disposal manifests within five (5) days after ultimate disposal.

3.6.3 Laboratory Accreditation

All laboratory testing for waste determinations shall be performed by a laboratory which has interim Accreditation-Applied status with the Louisiana Department of Environmental Quality (LDEQ) laboratory certification program. The name and address of the laboratory shall be included in the "Waste Classification, Handling, and Disposal Plan".

3.7 MAINTENANCE OF POLLUTION CONTROL FACILITIES

During the life of this contract the Contractor shall maintain all facilities constructed for pollution control under this contract as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created. Early in the construction period the Contractor shall conduct a training course that will emphasize all phases of environmental protection.

3.8 REPORTING OF POLLUTION SPILLS

In the event that an oil spill or chemical release occurs during the performance of this contract, the Contractor is required to contact the National Response Center, telephone number 1-800-424-8802 as soon as possible, or if telephone communication is not possible, the nearest U.S. Coast Guard office may be contacted by radio to report the spill, (33 CFR 153.203). The Contractor shall comply with any instructions from the responding agency concerning containment and/or cleanup of the spill.

-- End of Section --
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PART 1 GENERAL

1.1 SCOPE

The work specified in this section consists of the Contractor preparing, implementing, and diligently pursuing all measures required in the Storm Water Pollution Prevention Plan (SWPPP). The SWPPP consists of this Section, 01 57 23.00 12, and any and all references and attachments including existing and future signed certification statements. The purpose of the SWPPP is to control soil erosion and the resulting sediment to the extent necessary to prevent sediment from leaving the contract rights-of-way and prevent pollution of any water body caused by the runoff from the areas of construction activities under this contract, under the terms of PERMIT NO. LAR100000 copy attached at the end of this section), and as specified herein and shown on the drawings. The requirements of these specifications are supplemental to and shall become part of the overall Environmental Protection Plan required by Section 01 57 20.00 12 ENVIRONMENTAL PROTECTION. The Contractor shall review the SWPPP to determine requirements for compliance. In addition, the Contractor shall ascertain that his subcontractors have reviewed the plan, and that they comply with its provisions. The Contractor shall ensure that all subcontractors sign, "Certification Statements #1 and #2" (blank forms attached at the end of this section).

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4491 (1999a; R 2009) Water Permeability of Geotextiles by Permittivity


ASTM D4873 (2002; R 2009) Identification, Storage,
1.4 DEFINITIONS

a. Construction Owner - The construction owner is the party that has operational control over plans and specifications including the ability to make changes to those items. The Coastal Protection and Restoration Authority is the construction owner.

b. Construction Operators - The construction operators are the party having control over the plans and specifications and the party having day-to-day operational control over those activities at a project site which are necessary to ensure compliance with the SWPPP or other permit conditions. Both the Government and the Contractor are the construction operators.

c. Notice of Intent (NOI) - A document that is completed and submitted to the Louisiana Department of Environmental Quality as application for coverage to discharge under the PERMIT NO. LAR100000. (Copy provided at the end of this section.)

d. Notice of Termination (NOT) - A document that is completed and submitted to the Louisiana Department of Environmental Quality to terminate permission to discharge under the PERMIT NO. LAR100000. The NOT must be filed within 30 days after final stabilization of the construction site has been achieved or the Contractor is no longer the construction operator. (Copy provided at the end of this section.)

1.5 GENERAL

The Contractor shall implement the Storm Water Pollution Prevention Plan (SWPPP) specified in a manner which will meet the requirements of Section 01 57 20.00 12 ENVIRONMENTAL PROTECTION, and the requirements of the Louisiana Pollution Discharge Elimination System (LPDES) permit, PERMIT NO. LAR100000 effective October 1, 2009.

1.5.1 Environmental Assessment of Contract Deviations

The Contractor is advised that deviations from the SWPPP could result in the requirement for the Government to reanalyze the project from an environmental standpoint. Deviations from the SWPPP erosion control requirements as specified herein and as shown on the drawings which may have an environmental impact will require an extended review, processing, and approval time by the Government.

1.5.2 Notice Of Intent

Upon preparation of a complete SWPPP, the NOI will be submitted by the Government to the LDEQ as application for the Government's coverage under the terms of PERMIT NO. LAR100000. A copy of the Government's NOI, will be provided to the Contractor at the Pre-construction Conference for the Contractor's use in preparing their NOI. If a specific LPDES permit
applicable to this construction item has been received from the LDEQ in response to the NOI, a copy of the specific LPDES permit will also be provided to the Contractor. The Contractor shall make any necessary modification to this SWPPP; attach the Construction Owner / Operator certification statement provided at the end of this section to the SWPPP; and certify by signing the statement as the construction operator. The Contractor shall then submit an NOI to the LDEQ as application for his/her coverage under the terms of PERMIT NO. LAR100000, prior to initiating any construction activities. Certified mail is recommended for Contractor's proof of submittal. A copy of the Contractor's NOI submittal shall be provided to the Government representative at the time of submittal. LDEQ will provide a specific LPDES permit to the Contractor in response to that NOI submittal. The NOI's of both the Contractor and the Government, as well as the specific permits in response to the NOI, shall be posted at the job site by the Contractor. (Forms are attached at the end of this Section.)

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Stormwater Pollution Prevention Plan (SWPPP); G

A Louisiana Licensed Professional Engineer shall prepare and submit Stormwater Pollution Prevention Plan and Erosion Control Plan.

SD-02 Shop Drawings

Turbidity Curtain; G

SD-04 Samples

Silt Fence Geotextile; G

A sample, approximately 2 feet by 4 feet, of each geotextile that the Contractor plans to use shall accompany the certificate required below.

SD-07 Certificates

Silt Fence Geotextile; G

A mill certificate or affidavit shall be provided attesting that the geotextile meets the chemical, physical, and manufacturing requirements stated in this specification. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the geotextile supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile.

Geotextile shall not be delivered to the site until the geotextile is approved by the Government Representative.

SECTION 01 57 23.00 12 Page 5
Turbidity Curtain; G

Materials certificate shall be provided for the main parts of the turbidity curtain.

1.7 RECORD RETENTION REQUIREMENTS

1.7.1 Documents

The Contractor shall retain copies of the Storm Water Pollution Prevention Plan (SWPPP) and all reports required by the general permit, and all records of data used to complete the NOI, for a period of at least three years from the date that the construction site is finally stabilized. Records of the NOI as well as any data used to complete it, the SWPPP, and any reports required by PERMIT NO. LAR100000 shall be retained by the permittee for at least three years from the date that the site is finally stabilized.

1.7.2 Plan Accessibility

A copy of the SWPPP and a copies of all permits received, shall be retained at the construction site (or other local location accessible to the State Administration Authority and the public) from the date of construction initiation to the date of final stabilization. The Contractor shall have a copy of the plan available at a central location on-site for the use of all operators and those identified as having responsibilities under the plan whenever they are on the construction site. A notice shall be posted near the main entrance to the construction site with the following information: (1) the LPDES permit number for the project or a copy of the NOI if a permit has not yet been assigned; (2) the name and telephone number of a local contact person; (3) a brief description of the project; and (4) the location of the SWPPP if the site is inactive or does not have an on-site location to store the plan.

1.7.3 Activity Records

The dates of the following activities shall be recorded:

(1) Major grading activities occurred.

(2) Construction activities temporarily or permanently ceased.

(3) Stabilization measures were initiated.

1.7.4 LDEQ Correspondence

Any written correspondence with the LDEQ concerning the NOI, NOT, SWPPP, or discharges from any facility covered under PERMIT NO. LAR100000, shall be identified by permit number, if one has been assigned, and sent to the address below:

Louisiana Department of Environmental Quality
Office of Environmental Services
P.O. Box 4313
Baton Rouge, LA 70821-4313

Attn: Permits Division
1.8 MAINTENANCE AND SURVEILLANCE FEES

In accordance with the Section 00700 Standard General Conditions, Article 6.08. The Contractor shall, without additional expense to the Government, be responsible for paying any state required annual maintenance and surveillance fee for work associated with coverage under PERMIT NO. LAR100000.

1.9 EROSION AND SEDIMENT CONTROLS

The controls and measures required for controlling sediment during construction are described below.

1.9.1 Stabilization Controls

The stabilization practices to be implemented shall include fertilizing, seeding, and mulching as specified in Section 32 92 19.04 12 TURF ESTABLISHMENT AND MAINTENANCE or any other temporary measure to restrict erosion from the construction site. On the daily CQC Report, the Contractor shall record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs "Unsuitable Conditions" and "No Activity for Less Than 21 Days", stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

1.9.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

1.9.1.2 No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the fourteenth day after construction activity temporarily ceased. Stabilization practices shall be initiated on that portion of the site by the fourteenth day in the case where construction activities will not resume within 21 days after construction activities have ceased.

1.9.2 Structural Controls

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices.

1.9.2.1 Silt Fence Barrier

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be
properly installed, as specified in paragraph "INSTALLATION OF SILT FENCE BARRIER", to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). (Final removal of silt fence barriers shall be upon approval by the Government Representative.)

1.9.2.2 Turbidity Curtain

Turbidity curtain shall meet the requirements of the attached Publications "BMP-27 Turbidity Curtain, Type 1" in furnishing materials, placement, and removal of the turbidity curtain. It shall be installed in areas of water where it is impractical to install a silt fence.

1.9.2.3 Straw Bale Barrier

The Contractor shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in an area between a ridge and drain, bales shall be placed as work progresses, bales shall be removed/replaced/relocated as needed for work to progress in the drainage area) as shown on the drawings. Areas where straw bales are to be used are shown on the drawings. Final removal of straw bale barriers shall be upon approval by the Government Representative. Rows of bales of straw shall be provided as follows:

a. Along the downhill perimeter edge of all areas disturbed.

b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.

c. Along the toe of all cut slopes and fill slopes of the construction areas.

d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas. Rows shall be spaced as shown on the drawings.

e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Rows shall be spaced as shown on the drawings.

f. At the entrance to culverts that receive runoff from disturbed areas.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCE BARRIER

2.1.1 Silt Fence Geotextile

The geotextile shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make
the filaments resistant to deterioration due to ultraviolet and heat exposure. Geotextile shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The silt fence geotextile shall meet the following requirements:

### GEOTEXTILE FOR SILT FENCE

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<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Breaking Load, pounds</td>
<td>ASTM D4632</td>
<td>220 minimum</td>
</tr>
<tr>
<td>Grab Elongation at Ultimate, percent</td>
<td>ASTM D4632</td>
<td>20 maximum</td>
</tr>
<tr>
<td>Puncture Strength, pounds</td>
<td>ASTM D4833</td>
<td>130 minimum</td>
</tr>
<tr>
<td>AOS, U.S. Standard Sieve No.</td>
<td>ASTM D4751</td>
<td>30 - 70</td>
</tr>
<tr>
<td>Permittivity, per second</td>
<td>ASTM D4491</td>
<td>0.25 minimum</td>
</tr>
</tbody>
</table>

2.1.2 Steel T-Posts

The Contractor shall use steel T-posts for silt fence construction. Steel T-posts utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 7 feet.

2.1.3 Identification Storage and Handling

Geotextile shall be identified, stored and handled in accordance with ASTM D4873.

2.2 COMPONENTS OF TURBIDITY CURTAIN

The turbidity curtain shall consist of the components and materials meeting the requirements in the attached Publication "BMP-27 Turbidity Curtain, Type 1" at the end of this section.

2.3 COMPONENTS FOR STRAW BALE BARRIER

The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as bahia, Bermuda, Johnson grass, etc., furnished in air dry condition. The bales shall have a standard cross section of 14 inches by 18 inches. All bales shall be either wire-bound or string-tied. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCE BARRIER

The silt fence shall be located and installed as indicated on the contract drawings. Geotextile shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, geotextile shall be spliced together at a support post, with a minimum 6-inch overlap, and securely sealed. A trench shall be excavated approximately 4 inches wide and 6 inches deep on the upslope side of the location of the silt fence. The 4-inch by 6-inch trench shall be backfilled and the soil compacted over the geotextile. The geotextile
shall be attached to the land side of the post with wire or other method recommended by the manufacturer and such that a 6-inch length of geotextile is left unattached at the bottom of the post, the unattached geotextile embedded in the trench and the trench backfilled. It is the responsibility of the Contractor to maintain the integrity of the silt fence. The Contractor shall immediately correct any deficiencies. The silt fence shall be promptly repaired or replaced should it become damaged or otherwise ineffective. The silt fence is to remain in place upon completion of the project, or as directed by the Government Representative. Its maintenance shall be continual for that period of time for which excavated materials are placed in the area of the silt fence.

3.2 INSTALLATION OF TURBIDITY CURTAIN

The Contractor shall locate the turbidity curtain within the right-of-way to contain sediments in water at depths not suitable for installation of silt fence. The arrangement and layout shall be presented in the Work Plan without interference of construction operations from the turbidity curtain layout. The curtain can be removed once work in the area is completed and as approved by the Government Representative.

3.3 INSTALLATION OF STRAW BALE BARRIER

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

3.4 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

3.4.1 Silt Fence Barrier Maintenance

Silt fences shall be inspected in accordance with paragraph "INSPECTIONS" of this section. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the geotextile on a silt fence decompose or become ineffective, and the barrier is still necessary, the geotextile shall be replaced promptly. Sediment deposits shall be removed...
when deposits reach one-third of the height of the barrier. Sediments shall be utilized in the job or disposed of as construction debris. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 32 92 19.04 12 TURF ESTABLISHMENT AND MAINTENANCE.

3.5 INSPECTIONS

3.5.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every fourteen (14) calendar days, before anticipated storm events (or series of storm events such as intermittent showers over one or more days) expected to cause a significant amount of runoff, and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every two (2) weeks.

3.5.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the SWPPP shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

3.5.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP, maintenance performed, and actions taken. The report shall be furnished to the Government Representative within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site. Sample inspection reports (Exhibit D-2, Exhibit D-3, Exhibit D-4, and Table D-5) are included at the end of this section.

3.6 NOTICE OF TERMINATION

Upon stabilization and elimination of all storm water discharges authorized by PERMIT NO. LAR100000, or where the operator of all storm water discharges at a facility changes, a Notice of Termination (NOT) shall be certified and submitted by the Contractor to the Permits Division at the LDEQ. A copy of the NOT form is provided at the end of this section in Addendum C in Attachment A. Certified mail is recommended for proof of the NOT submittal. The NOT shall be submitted within 30 days of final stabilization of the construction site or when the Contractor is no longer the construction operator.
3.7 ADDITIONAL INFORMATION

(a) **Job description.** The project consists of diverting fresh water flow from the Mississippi River deep into the Maurepas Swamp wetlands. The project includes degrading river levee, construction of a gated intake structure at the River, headworks, a sand settling basin, a drainage pump station, a conveyance channel, installation of check valves on drainage pipes under I-10 rip rap weirs at Bayou Secret and Bourgeois Canal, box culverts under River Road I-10 and Airline Hwy crossings, box culverts under railroad crossings (KCS and CSX, removal and replacement or railroad tracks and embankment cuts).

(b) **Activity sequence.** The intended sequence of work is generally as follows: clearing and grubbing, build cofferdam, degrade existing river levee, build gated intake structure at the River, build sand settling basin, build drainage pump station, excavate for conveyance channel, build levee embankment for conveyance channel, install flow control valves, install box culverts under road crossings and railroad crossings, build rip rap weirs at Bayou Secret and Bourgeois Canal, embankment cuts, railroad work and place seeding, fertilizing and mulch on the new levee embankment.

(c) **Disturbed area.** The total area within the construction limits is approximately 200 acres.

(d) **Runoff coefficient.** An estimate of the runoff coefficient of the site for both preconstruction and post-construction conditions is approximately 0.45 (only in applicable locations of project).

(e) **Location.** The project is mostly located in St. John the Baptist Parish, Louisiana, at approximately latitude 30 deg, 03min, 03.36 sec. and longitude 90 deg, 30 min, 26.52 sec. The location map and vicinity map showing the location of the project are on the cover sheet of the construction drawing set.

(f) **Associated discharges.** There are no discharges from industrial activity other than construction.

(g) **The receiving bodies of water for storm water at present and after the project is completed are the Mississippi River, Maurepas Swamp, Hope Canal, Bourgeois Canal, Bayou Secret, and Lake Pontchartrain.**

(h) **Permit requirements.** Permit requirements are described in the copy of PERMIT NO. LAR100000 attached at the end of this section.
CERTIFICATION STATEMENT #1

Any person, including the construction owner/operator, signing documents (the SWPPP, modifications to the SWPPP, or other reports) under Part VI.G. of PERMIT NO. LAR100000 shall make the following certification.

(Contract Title)

(Permit Number)

(Document being Certified, such as SWPPP)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage this system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I also certify that a storm water pollution prevention plan, including both construction and post construction controls, has been prepared for the site in accordance with the permit and that such plan complies with approved State, Tribal and/or local sediment and erosion plans or permits and/or storm water management plans or permits. I am aware that signature and submittal of the Notice of Intent is deemed to constitute my determination of eligibility under one or more of the requirements of Permit Part I.A.3.e(1), related to the Endangered Species Act requirements. To the best of my knowledge, I further certify that such discharges and discharge related activities will not have an effect on properties listed or eligible for listing on the National Register of Historic Places under the National Historic Preservation Act, or are otherwise eligible for coverage under Part I.A.3.f of the permit. I am also aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature

________________________________________________________

Printed Name

________________________________________________________

Title

________________________________________________________

Company

________________________________________________________

Date

________________________________________________________

Telephone

________________________________________________________
CERTIFICATION STATEMENT #2

Any Contractor or subcontractor implementing any part of this plan must prepare and sign a copy of the following certification.

(Contract Title)

(Permit Number)

I certify, under penalty of law, that I understand the terms and conditions of the Louisiana Pollutant Discharge Elimination System (LPDES) general permit that authorizes storm water discharges associated with construction activity from the construction site identified as part of this certification.

Firm Name: __________________________________________________________
Address:  ____________________________________________________________
_________________________________________  Telephone No:  ____________
Signature:  ______________________  Title:  __________________________
Date:  _______________________________________________________________

-- End of Section --
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TRUCK WASH-DOWN RACKS

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1.2   MEASUREMENT AND PAYMENT

PART 2   PRODUCTS (NOT USED)

PART 3   EXECUTION
3.1   Truck Wash-Down Rack

-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SCOPE

The work specified in this section consists of the Contractor installing and maintaining approved truck wash-down rack(s) at the construction site and borrow site(s). All vehicles leaving the construction site shall have all soil and debris removed prior to entering or crossing any Parish roadways or State roadways.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

PART 3   EXECUTION

3.1  Truck Wash-Down Rack

The Contractor shall install and maintain approved truck wash-down rack to eliminate mud and debris transported onto public roads. All trucks utilized for hauling shall be pressure washed on the wash-down rack prior to departing the construction site. The truck wash-down rack shall be sized and located within the rights-of-way for the access road per the Contractor's proposed equipment and construction site layout.

1. The hard surfaced truck wash-down rack shall consist of a Contractor designed steel grated structure, wooden timber crane mats, or an equivalent method.

2. Surfacing meeting the requirements of Section 32 15 00.00 12 SURFACING (GRANULAR) shall be located between the truck wash-down rack and roadway or as shown on the drawings.

3. Truck wash-down racks shall be frequently inspected and maintained as needed.

4. All truck wash-down rack waste water and sediment shall be intercepted before draining offsite.

5. The mechanical street sweeper shall be onsite at all times to clean the streets. Failure of the Contractor to comply with these requirements shall result in the Contractor stopping all hauling operations until the streets are cleaned of debris.

6. Upon completion of the hauling operation, the Contractor shall remove the truck wash-down rack and all appurtenances from the construction site.

7. The area where the truck wash-down rack is located shall be
restored to the previous condition or better than prior to construction activities. All aggregate placed between the wash-down rack and the roadway shall be removed.

-- End of Section --
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CLOSEOUT SUBMITTALS

04/06

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1.2  SUBMITTALS
1.3  PROJECT RECORD DOCUMENTS
   1.3.1  As-Built Drawings
      1.3.1.1  Government Furnished Materials
      1.3.1.2  Working As-Built and Final As-Built Drawings
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1.4  MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING
1.5  OPERATION AND MAINTENANCE MANUALS
1.6  FINAL CLEANING

PART 2  PRODUCTS (NOT USED)

PART 3  EXECUTION (NOT USED)

-- End of Section Table of Contents --
PART 1  GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; G

Drawings showing final as-built conditions of the project. The final CADD as-built drawings shall consist of one (1) set of electronic CADD drawing files in the specified format, one (1) set of PDF, one (1) set of mylar drawings, two (2) sets of prints of the mylars, and one (1) set of the approved working as-built drawings.

SD-03 Product Data

Operations and Maintenance (O & M) Manuals; G

Submit O & M Manuals for all equipment.

1.3  PROJECT RECORD DOCUMENTS

1.3.1  As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.3.1.1  Government Furnished Materials

One (1) set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.3.1.2  Working As-Built and Final As-Built Drawings

The Contractor shall revise two (2) sets of paper drawings by red-line
process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Government Representative and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Government Representative will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Government Representative and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.
j. Modifications will be shown in accordance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Triangle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Triangle shall be placed by the detail or section title.

(4) For minor changes, a Modification Triangle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Triangle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Triangle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Triangle size shall be 1/2 inch on a side unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.3.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Government Representative after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.3.1.4 Qualifications of CADD personnel

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. The contractor shall submit the qualifications of the personnel who will prepare the CADD drawings for approval. The Contractor shall comply with the A/E/C CADD Standard requirements included on the electronic bid set CD for all drawing modifications.

1.3.1.5 Computer Aided Design and Drafting (CADD) Drawings

Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical.
to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The Contractor will be furnished "as-designed" drawings in Microstation V8 format compatible with a Windows XP operating system. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Government Representative will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

   (1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.

   (2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.

   (3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 20 days after Government approval of all of the working as-built drawings, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 10 days the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 day of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), one set of mylars, two sets of blue-line prints and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due.
the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Government Representative as specified in applicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Operations and Maintenance (O & M) Manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

1.6 FINAL CLEANING

The premises shall be left clean. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed.

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PART 3 EXECUTION (NOT USED)

-- End of Section --
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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

07/06

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PART 1   GENERAL

1.1   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


1.3   SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor must compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.3.1   Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.3.2   Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows.

1.3.3   Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or
revisions required by the Government Representative for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.3.4 Review and Approval

The Government's Representative must review the commissioned systems and equipment submittals for completeness and applicability. The Government's Representative must verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. This work is in addition to the normal review procedures for O&M data.

1.3.5 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.4.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.4.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.4.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.4.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.4.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.4.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.
1.4.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.4.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.4.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.4.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.4.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.4.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what
conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.4.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.4.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.4.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.4.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.4.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.4.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.4.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.4.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.
1.4.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.4.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.4.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the pumps, engines, hydraulic systems, etc.

1.4.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.4.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.4.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.4.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.
1.5 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package and the following for control systems:

a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor.

d. Full print out of all schedules and set points after testing and acceptance of the system.

e. Full as-built print out of software program.

f. Electronic File:

   (1) Assemble each manual into a composite electronically indexed file in PDF format. Provide HDD’s, DVD's or CD's as appropriate, so that each one contains all maintenance and record files, and also the Project Record Documents and Training Videos, of the entire program for this facility.

   (2) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

   (3) Link the index to separate files within the composite of files. Book mark maintenance and record files, that have a Table of Contents, according to the Table of Contents

g. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.6.1 Data Package

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Lubrication data
h. Preventive maintenance plan and schedule
i. Cleaning recommendations
j. Troubleshooting guides and diagnostic techniques
k. Wiring diagrams and control diagrams
l. Maintenance and repair procedures
m. Removal and replacement instructions
n. Spare parts and supply list
o. Product submittal data
p. O&M submittal data
q. Parts identification
r. Warranty information
s. Testing equipment and special tool information
t. Testing and performance data
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SCOPE

The work covered by this section consists of furnishing all equipment, material and labor required to perform all operations necessary for demolition and removal of concrete scour protection, asphalt roadway, concrete roadway, abandoned pipelines, degrade levees, railroad tracks and associated work as specified herein and as shown on the contract drawings.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6                   (1990; R 1998) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1               (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.4  GENERAL REQUIREMENTS

Do not begin demolition until authorized by the Government Representative. The work includes demolition and removal from project all resulting concrete rubbish and debris. Removal of rubbish and debris from job site shall be conducted daily, unless otherwise directed. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.5  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Existing Conditions; G
Demolition Plan; G
Notifications; G
Waste Management Plan; G

Proposed demolition and removal procedures for approval before work is started. The work includes demolition, removal from site, and disposal of all items indicated on the contract drawings in accordance with all applicable laws, codes, regulations, and ordinances. All work shall be performed with EM 385-1-1, ANSI A10.6, and all applicable OSHA standards, and all other local, state, and federal requirements as applicable to demolition work.

SD-07 Certificates
Receipts; G

Receipts or bills of lading, as specified. Indicate disposal sites and provide agreements of disposal.

1.6 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses", conform to the safety requirements contained in ANSI A10.6.

1.6.1 Notifications

1.6.1.1 General Requirements

Furnish timely notification of demolition projects to Federal, State, regional, and local authorities. Notify the State's environmental protection agency and the Government Representative in writing ten (10) working days prior to the commencement of work. A record of all notifications and the proceeding thereof shall be submitted to the Government Representative.

1.6.2 Receipts

The Contractor shall submit two (2) copies of all licenses, certifications, notifications, and receipts required or issued for the equipment, methods of disposal, and areas used for disposal of removed materials to the Government Representative. Contractor shall note special attention for any receipt or bill of lading for all hazardous or potentially hazardous materials removed from the work site.

1.7 EXISTING CONDITIONS DOCUMENTATION

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Government Representative showing the condition of structures and other facilities adjacent to areas of alteration or removal. The Contractor shall take photographs of existing site conditions. Photographs sized 4 inch by 6 inch will be acceptable as a record of existing conditions. Include in
the record the elevation of the top of foundation walls, finish ground elevations, levees, railroad tracks, possible conflicting electrical conduits, plumbing lines, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

1.8 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place. Repair or replace damaged items as approved by the Government Representative. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Do not destabilize flood protection and provide emergency support and closure capabilities where necessary. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Reinforcement for existing structures shall be designed by a registered professional engineer licensed in the State of Louisiana. Repairs, reinforcement, or structural replacement shall be submitted for approval as part of the Demolition Plan.

1.9 REQUIRED DATA

Prepare and submit a detailed Demolition Plan 30 days prior to commencing demolition work. Include in the plan: tools, equipment, and procedures necessary for careful removal and disposition of materials specified to be demolished while protecting existing property which is to remain undisturbed. The submittal shall include general layout drawings, equipment specifications, and all work platforms necessary for safe demolition and removal or recycle of demolished and deconstructed materials. Salvageable material may be recycled on site with the use of approved recycling methods. Contractor shall provide a schedule showing coordination with other work in progress and Waste Management Plan. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Demolition Plan shall be approved by the Government Representative prior commencement of work.

1.9.1 Plan and Procedures

The Contractor shall submit his plan to the Government Representative for approval. The plan shall include procedures to accomplish the following:

1) Schedule for completion of all demolition work included in the specifications and shown on the drawings.

2) Description of phasing for demolition activities shall be submitted together for the Government Representative's review and approval.

3) Plans for dismantling, removing and disposing or recycling of the existing structures including procedures and methods to provide necessary supports, lateral bracing and shoring when required.

4) Methods of storage, recycling, or disposal.
5) Proposals for control of environmental pollution.
6) Safety precautions to protect personnel and property.
7) All other associated work.

1.10 EXISTING CONSTRUCTION LIMITS AND PROTECTION

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove debris from work areas daily.

1.11 WEATHER PROTECTION

Contractor must coordinate demolition with flood protection and emergency closure plans. Flood protection offered by the area hurricane protection shall not be compromised as a result of demolition. Any demolition that requires an infringement upon existing levels of flood protection must have a plan to maintain existing flood protection. This plan must be pre-approved by the Government Representative before mobilization for demolition.

1.12 UTILITY SERVICES

Contractor shall protect against damage during demolition and deconstruction operations. Mandatory suspensions in utility services shall be coordinated with the Government Representative.

1.13 PROTECTION OF PERSONNEL

Before, during and after the demolition and deconstruction work the Contractor shall continuously evaluate the condition of the structure being demolished and deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.14 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.15 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Government Representative.

1.16 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to avoid the creation of a nuisance or hazard in the surrounding area. Do not use excessive water if it results in hazardous or objectionable conditions such as, but not limited to flooding, erosion, or pollution.
1.17 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency, LDEQ, and LAPDES requirements specified.

1.18 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.19 RAILROAD TRACKS

Comply with the AREMA, KCS and CN Railroad Company standards. The Contractor shall coordinate with KCS and CN Railroad Companies while working on or adjacent to railroad tracks.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions, or excavations resulting from demolition or deconstruction of structures. Special instructions for fill material used in protection levees or dikes are defined in Section 31 24 00.00 12 EMBANKMENT.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures on site for reconfigurations and reuse. No demolition of existing flood protection shall be done before securing temporary and/or new flood protection for the project area. Existing construction scheduled to be removed for reuse shall be disassembled accordingly. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse on site whenever possible.

3.1.1 Structures

a. Remove existing structures, levees, rail road tracks as indicated to be removed according to the Demolition Plan as shown in the contract drawings.

b. Demolish structures in a systematic manner from the top of the structure to the ground.

c. Locate demolition and deconstruction equipment throughout the project work area and remove materials so as to not impose excessive loads adjacent earthworks and existing structures to remain in place.

d. Do not demolish any existing flood protection structure before securing temporary and/or new flood protection during hurricane season (June 1 through December 1) or high river stages. See Contract drawings for historical high river stages. Temporary and/or new flood protection must be in place and approved by the Government Representative before proceeding with any demolition of existing
flood protection during hurricane season.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Government Representative. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made, mechanical adjustments been completed, and electronic sensors and conduit have been removed or relocated.

3.1.3 Reserved

3.1.4 Paving

Pavement designated to be removed becomes the property of the Contractor.

3.1.5 Concrete

Through cut concrete along straight lines where possible. Saw cut remaining concrete along straight lines to a depth of a minimum 2 inch.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except for reused items specified in related Sections, all materials and equipment removed and not reused, shall become the property of the Contractor and shall be removed from the work site. Title to materials resulting from demolition and deconstruction, and equipment to be removed, is vested in the Contractor upon approval of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Government Representative to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.2.2 Reuse of Materials and Equipment

Remove, relocate, or store materials and equipment listed in the Demolition Plan to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.2.3 Salvaged Materials and Equipment

Materials and equipment not to be reused that are listed in the Demolition Plan to be removed by the Contractor become property of the Contractor immediately upon removal.

a. Only materials approved by the Government Representative to be salvaged for this project can be stored on site. The Contractor must remove all other salvageable material from the project site at the Contractor's own expense before completion of any stage of the contract. Material salvaged by the Contractor shall not be sold on the site.
b. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver items reserved as property of the Government to the areas designated by the Government Representative.

3.2.4 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable, non-recyclable, and non-combustible material in the disposal area approved in SECTION 01 57 20.00 12 ENVIRONMENTAL PROTECTION.

3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport them in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan. Storage of removed materials on the project site is prohibited.

3.4.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted.

3.4.3 Removal from Limits of Construction

Transport waste materials removed from demolished and deconstructed structures, except waste soil, for legal disposal. Dispose of waste soil as directed by the Government Representative.

-- End of Section --
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DIVISION 03 - CONCRETE

SECTION 03 11 14.00 12

FORMWORK FOR CONCRETE

04/08

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-- End of Section Table of Contents --
PART 1     GENERAL

1.1     SCOPE

The work covered by this section consists of furnishing all materials and equipment and performing all labor for the forming of concrete in the structures included in these specifications.

1.2     RELATED WORK SPECIFIED ELSEWHERE

a.  Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

b.  Section 03 21 00.00 12 REINFORCING STEEL.

c.  Section 03 15 13.00 12 EXPANSION JOINTS AND WATERSTOPS IN CONCRETE.

d.  Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.3     MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.4     REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 347                         (2004; Errata 2008; Errata 2012) Guide to
                                Formwork for Concrete

ASTM INTERNATIONAL (ASTM)

ASTM C31                         (2010) Standard Practice for Making and
                                Curing Concrete Test Specimens in the Field

                                Compressive Strength of Cylindrical
                                Concrete Specimens

                                Testing Concrete and Concrete Aggregates
                                for Use in Construction and Criteria for
                                Laboratory Evaluation

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1                              (1995) Construction and Industrial Plywood
1.5 DESIGN REQUIREMENTS

The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. The formwork shall be designed for anticipated live and dead loads and shall comply with the tolerances specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE, paragraph "CONSTRUCTION TOLERANCES". However, for surfaces with an ACI Class A surface designation, the allowable deflection for facing material between studs, for studs between walers and walers between bracing shall be limited to 0.0025 times the span. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. The adequacy of formwork design and construction shall be monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Drawings and design computations for all formwork required shall be submitted at least 45 days either before fabrication on site or before delivery of prefabricated forms. If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.

SD-03 Product Data

Materials

Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, form coating, and form-lining materials.

SD-05 Design Data

Formwork Not Supporting Weight of Concrete

If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.

Formwork Supporting Weight of Concrete

If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.
Quality Control

The Contractor shall submit field inspection reports for concrete forms and embedded items.

Form Removal

If forms are to be removed in less than 24 hours on formwork not supporting the weight of concrete, the evaluation and results of the control cylinder tests shall be submitted to and approved before the forms are removed.

1.7 SHOP DRAWINGS

The shop drawings and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

1.8 QUALITY CONTROL

1.8.1 General

Forms, embedded items, ties and other accessories as specified in paragraph "ACCESSORIES" shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Government Representative that they are ready to receive concrete. Inspection of forms for concrete shall include a detailed evaluation of leakage control measures, type and application of release agent, and form cleanliness to avoid dirt transfer to the concrete.

1.8.2 Reporting

The results of each inspection shall be reported in writing and shall include, but not be limited to, the following:

(1) Removal of extraneous material from forms.
(2) Check of joints for mortar tightness.
(3) Type of form material required for the concrete finish.
(4) Falsework and/or bracing.
(5) Alignment, tolerances, and dimensions.
(6) Chamfering.
(7) Form coating.

The original and two copies of these reports, as well as corrective action taken, shall be furnished to the Government daily. The format of these reports shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.
PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Form and Form Liners

Form and form liners shall be fabricated with facing materials that will produce a finish meeting the specified construction tolerance requirements and the following surface classifications as defined in ACI 347.

2.1.1.1 Class "A" Finish

This class of finish shall apply to all exterior formed surfaces not covered by backfill. The form facing material shall be composed of new, well matched tongue and groove lumber or new plywood panels conforming to DOC PS1, either Grade B-B (concrete form), Class I or Grade B-B High Density Concrete Form Overlay, Class 1.

2.1.1.2 Class "B" Finish

This class of finish shall apply to culvert interior surfaces and all surfaces except those specified to receive a Class A or Class D finish. The form facing material shall be composed of tongue-and-groove or shiplap lumber, plywood conforming to PS1, Grade B-B concrete form, tempered concrete form hard board or steel. Steel lining on wood sheathing will not be permitted.

2.1.1.3 Class "D" Finish

This class of finish shall apply to all unexposed surfaces. The form facing may be of wood or steel.

2.1.2 Form Coating

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

2.2 ACCESSORIES

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Removable tie rods shall not be allowed in all locations. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete. Safety factors for form ties, anchors and hangers shall comply with the standards of ACI 347, Table 2.4. The use of tapered ties is not allowed.
PART 3  EXECUTION

3.1  INSTALLATION

3.1.1  Form Construction

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. The Contractor shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class specified in paragraph "Forms and Form Liners" and tolerances specified in paragraph "DESIGN REQUIREMENTS". Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

3.1.2  Chamfering

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated twelve inches outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.1.3  Coating

Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The use of waste oil or used oil as a form-release agent or form oil is prohibited. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete. Coatings that discolor concrete or are incompatible with their concrete materials are prohibited.

3.1.4  Tieing

Form tie bolts for ribbed surface walls shall be located only or as approved. They shall be installed so as to prevent leakage. Tie holes in the form liner shall be accomplished by drilling or similar means to achieve a smooth tight hole. Prevention of leakage through tie holes shall be the responsibility of the Contractor. Tie bolts through the form liner shall occur in the valley between fractured ribs. No form tie which leaves a formed hole completely through the floodwall, such as a tapered tie bolt, may be used.
3.2 FORM REMOVAL

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed as specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE, paragraph "Formed Surface Repair". Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C31 and ASTM C39 at the expense of the Contractor by an independent laboratory that complies with ASTM C1077 and shall be tested within 4 hours after removal from the site.

3.2.1 Formwork Not Supporting Weight of Concrete

Formwork for walls, columns, sides of beams, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than twenty-four (24) hours of cumulative time, not necessarily consecutive, after concrete placement is completed during which the temperature of the air surrounding the concrete is above below 50 degrees Fahrenheit. Control cylinders shall be prepared for each set of forms to be removed before twenty-four (24) hours. The stability of the concrete shall be evaluated by a Louisiana licensed structural engineer prior to early removal of the forms. The Contractor shall submit design data for the formwork for approval of the Government Representative.

3.2.2 Formwork Supporting Weight of Concrete

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders indicate evidence the concrete has attained at least seventy-five percent of the compressive strength required for the structure in accordance with the quality and location requirements of Section 03 31 00.00 12 CAST IN-PLACE STRUCTURAL CONCRETE. The Contractor shall submit design data for the formwork for approval of the Government Representative.
3.3 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Government Representative that they are ready to receive concrete. The results of each inspection shall be reported in writing.

-- End of Section --
PART 1 GENERAL

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1.4 REFERENCES
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

This section covers the materials, techniques and workmanship requirements for forming expansion joints and waterstops in concrete.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   RELATED WORK SPECIFIED ELSEWHERE

Major requirements for concrete work are specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

1.4   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM D624   (2000; R 2012) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers


ASTM D792   (2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Waterstops; G

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-03 Product Data

Preformed Expansion Joint Filler

Sealant

Waterstops; G

Hydrophilic Waterstops; G

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops. Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

SD-04 Samples

Compression Seals and Lubricant

Specimens identified to indicate the manufacturer, type of
material, size and quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 9 feet of 1 inch nominal width or wider seal or a piece not less than 12 feet of compression seal less than 1 inch nominal width. One quart of lubricant shall be provided.

Field-Molded

One gallon of field-molded sealant and one quart of primer (when primer is recommended by the sealant manufacturer) identified to indicate manufacturer, type of material, quantity, and shipment or lot represented.

Non-metallic Material

Waterstop materials and splice samples shall be submitted for inspection and testing and shall be identified to indicate manufacturer, type of material, size and quantity of material and shipment represented. Each material sample shall be a piece not less than 12 inches long cut from each 200 feet of finished waterstop furnished, but not less than a total of four linear feet of each type and size furnished. For spliced segments of waterstops to be installed in the work, one spliced sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site shall be furnished for inspection and testing. The spliced samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each spliced sample shall be not less than 12 inches long.

SD-07 Certificates

Preformed Expansion Joint Filler

Sealant

Waterstops

Certified manufacturer's test reports shall be provided for premolded expansion joint filler strips to verify compliance with applicable specification.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Preformed Expansion Joint Filler Strips

Preformed expansion joint filler strips shall conform to ASTM D1752, Type I. Wood, cork, or other cellulose-based material shall not be used.

2.1.2 Joint Seals and Sealants

2.1.2.1 Field Molded Sealants and Primer

Field molded sealants and primer shall conform to ASTM C920, Type M, Grade NS, Class 25, use NT for non-horizontal joints and Type M, Grade P, Class 25, use T for horizontal joints. Bond breaker material shall be
polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, nonshrink, nonreactive with sealant, and nonabsorptive material type such as extruded butyl or polychloroprene foam rubber.

2.1.2.2 Compression Seals and Lubricant

Compression seals shall conform to ASTM D2628; lubricant for installation shall conform to ASTM D2835.

2.2 WATERSTOPs

2.2.1 Non-Metallic Waterstops

Non-metallic waterstops shall be manufactured from prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572-74.

Polyvinyl chloride retrofit waterstop system shall consist of a "Tee-shaped" PVC waterstop profile, pre-drilled stainless steel batten bars and concrete nails. The waterstop profile shall have a 9-inch base width with 1/2-inch thickness and shall meet or exceed the following requirements.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Required Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water absorption</td>
<td>ASTM D570</td>
<td>0.15 percent max.</td>
</tr>
<tr>
<td>Tear Resistance</td>
<td>ASTM D624</td>
<td>200 lb/in min.</td>
</tr>
<tr>
<td>Ultimate Elongation</td>
<td>ASTM D638</td>
<td>350 percent max.</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D638</td>
<td>2,000 psi min.</td>
</tr>
<tr>
<td>Low Temperature Brittleness</td>
<td>ASTM D746</td>
<td>No failure @ -35 degrees F</td>
</tr>
<tr>
<td>Stiffness in Flexure</td>
<td>ASTM D747</td>
<td>600 psi min.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>ASTM D792</td>
<td>1.45 max.</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>ASTM D2240</td>
<td>79 +/-3</td>
</tr>
<tr>
<td>Tensile Strength after accelerated extraction</td>
<td>COE CRD-C 572</td>
<td>1,850 psi min.</td>
</tr>
<tr>
<td>Elongation after accelerated extraction</td>
<td>COE CRD-C 572</td>
<td>300 percent min.</td>
</tr>
<tr>
<td>Effect of Alkalies after 7 days: Weight Change</td>
<td>COE CRD-C 572</td>
<td>between -0.10/+0.25 percent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hardness Change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- 5 points</td>
</tr>
</tbody>
</table>

2.2.2 Hydrophilic Waterstops

All hydrophilic waterstops shall be preformed hydrophilic non-vulcanized rubber strips. Hydrophilic waterstop shall be a bentonite based product
which swells in contact with water. Hydrophilic waterstop shall comply with the minimum standards listed below:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>UNIT</th>
<th>ASTM</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>HS</td>
<td>D 2240</td>
<td>30 (+/- 6)</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>Lbs/In</td>
<td>D 412</td>
<td>100 Min.</td>
</tr>
<tr>
<td>Elongation</td>
<td>%</td>
<td>D 412</td>
<td>500 Min.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>---</td>
<td>D 792</td>
<td>1.18 (+/- 0.15)</td>
</tr>
</tbody>
</table>

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Materials Tests

2.3.1.1 Field-Molded Sealants

Samples of sealant and primer, when use of primer is recommended by the manufacturer, as required in paragraph "Field Molded Sealants and Primer", shall be tested by and at the expense of the Government for compliance with paragraph "Field Molded Sealants and Primer". If the sample fails to meet specification requirements, new samples shall be provided and the cost of retesting will be deducted from payments due the Contractor at a rate of $8,000 per sample.

2.3.1.2 Non-Metallic Waterstops

Samples of materials and splices as required in paragraph "SUBMITTALS" shall be visually inspected and tested by and at the expense of the Government for compliance with COE CRD-C 513 or COE CRD-C 572-74 as applicable. If a sample fails to meet the specification requirements, new samples shall be provided and the cost of retesting will be deducted from payments due the Contractor at the rate of $920.00 (for materials complying with COE CRD-C 513) or $810.00 (for materials complying with COE CRD-C 572-74) per material sample retested and $150.00 per splice sample retested.

2.3.2 Splicing Waterstops

2.3.2.1 Procedure and Performance Qualifications

Procedure and performance qualifications for splicing waterstops shall be demonstrated in the presence of the Government Representative.

2.3.2.2 Non-Metallic Waterstops

Procedure and performance qualifications for splicing non-metallic material waterstops shall be demonstrated by the manufacturer at the factory and the Contractor at the job site by each making three spliced samples of each size and type of finished waterstop.

PART 3 EXECUTION

3.1 INSTALLATION

Joint locations and details, including materials and methods of installation of joint fillers and waterstops, shall be as specified, as shown, and as directed. In no case shall any fixed metal be continuous through an expansion joint.
3.1.1 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. No wood, cork, or other cellulose-based material shall remain in the joints. The Contractor may use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust, which shall be blown out of the groove with oil-free compressed air.

3.1.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degrees F. Immediately prior to installation of field molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents or other means as recommended by the sealant manufacturer. The joints shall be dry prior to filling with sealant. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.1.3 Joints With Preformed Compression Seals

The joint seals shall be installed with equipment which shall be capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal and with no more than 5 percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant, and the seal shall be installed to the depth indicated with joint installation equipment. Butt joints shall be coated with liberal applications of lubricant.

3.1.4 Waterstops

Waterstops shall be carefully and correctly positioned during installation to eliminate faulty installation that may result in joint leakage. Adequate provision shall be made to support and protect the waterstops during the progress of work. Any waterstop punctured or damaged shall be replaced or repaired at the Contractor's expense. The concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

3.1.5 Splices

Joints in waterstops shall be spliced together by qualified splicers using the approved splicing procedures to form a continuous watertight diaphragm. Splices shall be as followed:

a. Non-Metallic Waterstops - All splices shall be made on a bench in
a temporary shop provided at the site of the installation or at the manufacturer's plant. A miter guide and portable power saw shall be used to cut the ends to be joined to insure good alignment and contact between joined surfaces. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions and the like) shall be maintained across the splice.

b. Rubber Waterstops - Splices shall be vulcanized in accordance with the manufacturer's recommendations.

c. Polyvinylchloride Waterstops - Splices shall be made by heat sealing the adjacent surfaces in accordance with the approved procedure. A thermostatically controlled electrical heat source shall be used to make all splices. The correct temperature at which splices should be made will differ with the material concerned but the applied heat should be sufficient to melt but not char the plastic. Waterstops shall be reformed at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled and bent by hand in as sharp an angle as possible, shall show no sign of separation.

-- End of Section --
PART 1 GENERAL

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1.2 MEASUREMENT AND PAYMENT
1.3 REFERENCES
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1.5 QUALITY CONTROL
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1.5.2 General
1.5.3 Reporting

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2.1.1 Reinforcing Steel
2.1.2 Accessories
2.1.2.1 Bar Supports
2.1.2.2 Wire Ties

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3.1.1 Hooks and Bends
3.1.2 Placing Tolerances
3.1.2.1 Spacing of Bars
3.1.2.2 Concrete Cover
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all equipment, materials and labor for providing and placing steel bars, and accessories for concrete reinforcement.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318/318R   (2009) Building Code Requirements for Structural Concrete and Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A615   (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication and Placement; G

The Contractor shall prepare and submit complete shop drawings to the Government Representative for approval in accordance with specified requirements. Shop drawings shall include the details of bar supports including types, sizes, spacing and sequence.
SD-03 Product Data

Materials

A system of identification which shows the disposition of specific lots of approved materials in the work shall be established and submitted before completion of the contract.

SD-06 Test Reports

Materials
Tests, Inspections, and Verifications

Certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications shall be furnished for each steel shipment and identified with specific lots prior to placement.

1.5 QUALITY CONTROL

1.5.1 Materials Tests

The Contractor shall have required material tests performed by an approved laboratory to demonstrate that the materials are in conformance with the specifications. Tension tests shall be performed on full cross section specimens in accordance with ASTM E8-04, using a gage length that spans the extremities of specimens with welds or sleeves included. Tests shall be at the Contractor's expense.

1.5.2 General

The Contractor shall establish and maintain quality control for proper installation of all work covered in this section to assure compliance with contract specifications and maintain records of his quality control for all construction operations including but not limited to the following:

(1) Minimum concrete cover of reinforcement steel.

(2) Number, size, and location of placement.

(3) Maintain adequate splicing lengths where required.

(4) Tests, Inspections, and Verifications.

1.5.3 Reporting

The original and two copies of these records and tests, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2 PRODUCTS

2.1 MATERIALS

The Contractor shall furnish procedures for the disposition of the lots of materials, test reports, and material certificates showing conformance to the requirements herein, including tests, inspections, and verifications.
2.1.1 Reinforcing Steel

Billet steel bars shall conform to ASTM A615, Grade 60 for bar sizes 3 through 11, including the following requirements:

1. Tension test specimens shall be bars of full cross section as rolled for all sizes.

2. The bend test requirements shall be based upon 180-degree bends of full size bars for all grades of steel. The bend diameters for bend tests shall be as indicated in the following table and shall be measured on the inside of bars:

<table>
<thead>
<tr>
<th>Bar Size</th>
<th>Maximum Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3, #4 and #5</td>
<td>3 1/2 bar diameters</td>
</tr>
<tr>
<td>#6, #7 and #8</td>
<td>5 bar diameters</td>
</tr>
<tr>
<td>#9, #10 and #11</td>
<td>7 bar diameters</td>
</tr>
</tbody>
</table>

2.1.2 Accessories

2.1.2.1 Bar Supports

Bar supports shall conform to ACI SP-66. Supports for bars in concrete with formed surfaces exposed to view or to be painted shall be plastic-coated wire, stainless steel or precast concrete supports. Precast concrete supports shall be wedged-shaped, not larger than 3-1/2 by 3-1/2 inches, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish surfaces.

2.1.2.2 Wire Ties

Wire ties shall be 16 gage or heavier black annealed wire.

PART 3 EXECUTION

3.1 PLACEMENT

Reinforcement steel and accessories shall be placed as specified herein, shown on the drawings and on approved shop drawings. Holes cut in steel sheet piling for passing reinforcing bars shall not exceed 2 inches in diameter. Where holes fall in the web of the steel sheet pile, the hole shall be slotted 4 inches horizontally to accommodate passing the reinforcing bars. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318/318R. Steel reinforcement shall be fabricated to shapes and dimensions shown, placed where indicated within specified tolerances and adequately supported during concrete placement. At the time of concrete placement all steel shall be free from loose, flaky rust, scale (except tight mill scale), mud, oil, grease or any other coating that might reduce the bond with the concrete.

3.1.1 Hooks and Bends

Reinforcement bars shall be mill or field-bent. All steel shall be bent cold unless authorized. No steel bars shall be bent after being partially
embedded in concrete unless indicated or authorized. No steel bars partially embedded in concrete shall be field bent unless indicated on the drawings or otherwise authorized. All hooks or bends shall be in accordance with ACI 318/318R.

3.1.2 Placing Tolerances

3.1.2.1 Spacing of Bars

Bars shall be spaced as indicated on the drawings or as otherwise directed. The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 1 inch, whichever is less.

3.1.2.2 Concrete Cover

The minimum and maximum concrete cover of main reinforcement steel shall be as indicated on the drawings. The concrete tolerances shall be as follows:

<table>
<thead>
<tr>
<th>MINIMUM COVER</th>
<th>VARIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 inch</td>
<td>plus 1/2 inch</td>
</tr>
<tr>
<td>4 inch</td>
<td>plus 3/8 inch</td>
</tr>
<tr>
<td>3 inch</td>
<td>plus 3/8 inch</td>
</tr>
<tr>
<td>2 inch</td>
<td>plus 1/4 inch</td>
</tr>
<tr>
<td>1-1/2 inch</td>
<td>plus 1/4 inch</td>
</tr>
<tr>
<td>1 inch</td>
<td>plus 1/8 inch</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>plus 1/8 inch</td>
</tr>
</tbody>
</table>

3.1.3 Lap Splices

Lap splices shall be used only for bars smaller than size #14. Bar laps may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete, but shall not be spaced farther apart than one fifth the required length of lap nor 6 inches. Lengths of laps for bars shall conform to the requirements of ACI 318/318R, except when otherwise shown on the drawings.

-- End of Section --
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1.3 RELATED WORK SPECIFIED ELSEWHERE
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   1.6.2 Reporting
1.7 DESIGN AND PERFORMANCE REQUIREMENTS
   1.7.1 Strength
   1.7.2 Construction Tolerances
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   2.1.2 Blended Hydraulic Cement
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   2.3.2 Water-Reducing or Retarding Admixture
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2.7 JOINT SEALANTS - FIELD MOLDED SEALANTS
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2.10 FORM COATINGS
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   3.1.5.2 Concrete Made by Volumetric Batching and Continuous Mixing
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   3.2.2 Consolidation
   3.2.3 Cold-Weather Requirements
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   3.4.2 Finishing Formed Surfaces
   3.4.3 Finishing Unformed Surfaces
      3.4.3.1 Float Finish
      3.4.3.2 Trowel Finish
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      3.4.3.4 Expansion and Contraction Joints

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3.7 CONTRACTOR'S TESTS AND INSPECTIONS
   3.7.1 General
   3.7.2 Inspection Details and Frequency of Testing
      3.7.2.1 Preparations for Placing
      3.7.2.2 Air Content
      3.7.2.3 Slump
      3.7.2.4 Consolidation and Protection
   3.7.3 Action Required
      3.7.3.1 Placing
      3.7.3.2 Air Content
      3.7.3.3 Slump
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, labor, materials, equipment, and performing all operations necessary for batching, transporting, placing and finishing concrete for the manholes, catch basins, concrete slabs, footings for poles, pipe supports, equipment pads, and all ancillary structures as specified herein or as shown on the drawings.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   RELATED WORK SPECIFIED ELSEWHERE

a.  Section 03 15 13.00 12 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

b.  Section 03 21 00.00 12 REINFORCING STEEL.

c.  Section 03 11 14.00 12 FORMWORK FOR CONCRETE.

1.4   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 308R       (2001; R 2008) Guide to Curing Concrete

ACI 318/318R   (2009) Building Code Requirements for Structural Concrete and Commentary

ACI 347        (2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M   (2006; E 2006) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A 615/A 615M   (2006a) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
<table>
<thead>
<tr>
<th>ASTM Standard</th>
<th>Title</th>
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<tbody>
<tr>
<td>C 231</td>
<td>Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method (2004)</td>
</tr>
<tr>
<td>C 618</td>
<td>Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete (2005)</td>
</tr>
<tr>
<td>C 685/C 685M</td>
<td>Concrete Made by Volumetric Batching and Continuous Mixing (2005)</td>
</tr>
<tr>
<td>Standard Number</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------</td>
</tr>
</tbody>
</table>

**U.S. ARMY CORPS OF ENGINEERS (USACE)**

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COE CRD-C 400</td>
<td>(1963) Requirements for Water for Use in Mixing or Curing Concrete</td>
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</tbody>
</table>


<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSSRB 1003.02</td>
<td>Aggregates for Portland Cement Concrete and Mortar</td>
</tr>
</tbody>
</table>

**U.S. GENERAL SERVICES ADMINISTRATION (GSA)**

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS CCC-C-467</td>
<td>(Rev C) Cloth, Burlap, Jute (or Kenaf)</td>
</tr>
</tbody>
</table>

### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- **SD-03 Product Data**
  - Air-Entraining Admixture
  - Water-Reducing or Retarding Admixture
  - Other Admixtures
  - Curing Materials
  - Reinforcing Steel
  - Waterstops
  - Latex Bonding Compound
  - Nonshrink Grout
  - Concrete Mixture Proportions; G

  Manufacturer's literature which demonstrates compliance with
these specifications shall be submitted for the above materials.

Batching and Mixing Equipment

Batching and mixing equipment will be accepted on the basis of manufacturer's data, which demonstrates compliance with the applicable specifications. The name and location of the batch plant shall be furnished.

Conveying and Placing Concrete

The methods and equipment for transporting, handling, depositing, and consolidating the concrete shall be submitted to the Government Representative prior to the first concrete placement.

Formwork

Formwork design shall be submitted prior to the first concrete placement.

SD-06 Test Reports

Aggregates

Aggregates will be accepted on the basis of certificates of compliance and test reports that show the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

Concrete Mixture Proportions; G

At least 30 days prior to placement of concrete, the contractor shall submit to the Government Representative the mixture proportions that will produce concrete of the quality required. Mixture proportions shall include the dry weights of each cementitious material; the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project. Documentation complying with paragraph 5.3.3 of ACI 318/318R shall be submitted to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

SD-07 Certificates

Cementitious Materials

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted. Cementitious material will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by current mill test reports stating that the material meets the requirements of the specification under which it is furnished. If a blended product meeting ASTM C 595 is to be used, the manufacturer shall also certify in writing that the amount of pozzolan or ground
granulated blast-furnace (GGBF) slag in the finished cement will not vary more than plus or minus 5.0 mass percent of the finished cement from lot to lot or within a lot.

Aggregates

Aggregates will be accepted on the basis of certificates of compliance and tests reports that show the material(s) meet the quality and grading requirements of the specifications under which it is furnished. The gradation test for the fine aggregate shall include the No. 8 and No. 30 sieve sizes. The name and location of the pit shall also be furnished.

1.6 QUALITY CONTROL

1.6.1 General

The Contractor shall establish and maintain quality control for concrete operations to assure compliance with contract requirements and maintain records of his/her quality control for all construction operations including but not limited to the following:

(1) Equipment. Type, size, and suitability for construction of the prescribed work.

(2) Formwork. Verify dimensions and finish elevations for compliance with drawings.

(3) Embedded Items. Verify all embedded items are in place before concrete placement.

(4) Utilities. Verify utility stub-outs are in placed and secured before concrete placement.

(5) Concrete. Verify concrete mix is correct for intended use.

(6) Protection and Curing. Verify concrete is protected and cured properly.

(7) Control Testing.

(a) Aggregate Tests.

(b) Air Content Tests.

(c) Slump Tests.

1.6.2 Reporting

The original and two copies of these records of inspections and tests, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.7 DESIGN AND PERFORMANCE REQUIREMENTS

The Government will maintain the option to sample and test joint sealer, joint filler material, waterstops, aggregates and concrete to determine compliance with the specifications. The Contractor shall provide
facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Samples of aggregates shall be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143/C 143M and ASTM C 231, respectively, when cylinders are molded. Compression test specimens shall be made, cured, and transported in accordance with ASTM C 31/C 31M. Compression test specimens will be tested in accordance with ASTM C 39/C 39M. Samples for strength tests shall be taken not less than once each shift in which concrete is produced. A minimum of three (3) specimens will be made from each sample; two (2) will be tested at 28 days (90 days if pozzolan or GGBF slag is used) for acceptance, and one (1) will be tested at 7 days for information.

1.7.1 Strength

Acceptance test results will be the average strengths of two specimens tested at the specified design age. The strength of the concrete will be considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, \( f'c \), and no individual acceptance test result falls below \( f'c \) by more than 500 psi.

1.7.2 Construction Tolerances

A Class "A" finish shall apply to all surfaces except those specified to receive a Class "D" finish. A Class "D" finish shall apply to all surfaces which will be permanently concealed after construction. The requirements for the classes of finish shall be as specified in ACI 347.

1.7.3 Concrete Mixture Proportions

Concrete mixture proportions shall be the responsibility of the Contractor. Specified compressive strength shall be 3,000 psi at 28 days (90 days if pozzolan or slag is used). The nominal maximum size coarse aggregate shall be 3/4-inch. The air content shall range from 4.5 to 7.5 percent. The slump shall range from 2 to 5 inches. The maximum water to cementitious materials ratio shall be 0.50. If pozzolan is used, it shall range from 15 to 35 percent by weight of the total cementitious materials.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement, portland cement in combination with pozzolan or blended hydraulic cement and shall conform to appropriate specifications listed:

2.1.1 Portland Cement

ASTM C 150, low alkali, Type I, II, or III.

2.1.2 Blended Hydraulic Cement

Blended hydraulic cement shall meet the mortar expansion limits found in Table 2 of ASTM C 595. Admixture additions shall not be included in the blended cement.
2.1.3 Pozzolan, other than Silica Fume
Pozzolan shall conform to ASTM C 618, Class C or F, with the Multiple Factor and the Effectiveness in Controlling Alkali-Silica Reaction requirements of Table 3. Test results showing that the proposed combination of cementitious materials and aggregates will expand less than 0.10% in 16 days when tested in accordance with ASTM C 1567 may be substituted for the Effectiveness in Controlling Alkali-Silica Reaction test.

2.1.4 Ground Granulated Blast-Furnace Slag
Ground Granulated Blast-Furnace (GGBF) Slag shall conform to ASTM C 989, Grade 100 or 120.

2.2 AGGREGATES
Aggregates shall conform to ASTM C 33, except as specified otherwise herein. Coarse aggregate shall meet the additional requirements for Class 4M or better or LSSRB 1003.02. Aggregates shall conform to the grading requirements of either ASTM C 33 or, LSSRB 1003.02. Recycled portland cement concrete and lightweight coarse aggregate shall not be used.

2.3 ADMIXTURES
Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the Contractor at the request of the Government Representative and shall be rejected if test results are not satisfactory.

2.3.1 Air-Entraining Admixture
Air-entraining admixture shall meet the requirements of ASTM C 260.

2.3.2 Water-Reducing or Retarding Admixture
Water-reducing or retarding admixtures shall meet the requirements of ASTM C 494/C 494M, Type A, B, or D. High-range water reducing admixture Type F or G may be used only when approved by the Government Representative, approval being contingent upon particular placement requirements as described in the Contractor's Quality Control Plan.

2.4 WATER
Water for mixing and curing shall be fresh, clean, drinkable, and free from injurious amounts of oil, acid, salt, sugar or alkali, except that undrinkable water may be used if it meets the requirements of COE CRD-C 400.

2.5 REINFORCING STEEL
Reinforcing steel bar shall conform to the requirements of ASTM A 615/A 615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A 185/A 185M. Details of reinforcement not shown on drawings shall be in accordance with ACI 318/318R, Chapters 7 and 12.
2.6 EXPANSION JOINT FILLER STRIPS

Expansion joint filler strips shall conform to ASTM D 1752, Type I or IV.

2.7 JOINT SEALANTS - FIELD MOLDED SEALANTS

Joint sealants - field molded sealants shall conform to ASTM C 920, Type M, Grade NS, Class 25, use NT for non-horizontal joints and Type M, Grade P, Class 25, use T for horizontal joints. Bond-breaker material shall be polyethylene tape, coated paper, metal foil, or similar type materials. The backup material shall be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.8 WATERSTOPS

Waterstops shall conform to Section 03 15 13.00 12 Expansion Joints and Waterstops in Concrete.

2.9 FORMWORK

Formwork shall conform to Section 03 11 14.00 12 FORMWORK FOR CONCRETE. The design of the formwork as well as its construction shall be the responsibility of the Contractor.

2.10 FORM COATINGS

Forms for exposed surfaces shall be coated with nonstaining form oil, which shall be applied shortly before concrete is placed.

2.11 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96.

2.12 CURING MATERIALS

Curing materials shall conform to the following requirements.

2.12.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

2.12.2 Membrane-Forming Curing Compound

ASTM C 309, Type 1-D or 2, Class A.

2.12.3 Burlap

Burlap used for curing shall conform to FS CCC-C-467.

2.13 LATEX BONDING COMPOUND

Latex bonding agent for bonding fresh to hardened concrete shall conform
2.14 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107/C 1107M and shall be a commercial formulation suitable for the application proposed.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 General

Construction joints shall be prepared to expose coarse aggregate, and the surface shall be clean, damp, and free of laitance. Ramps and walkways, as necessary, shall be constructed to allow safe and expeditious access for concrete and workmen. Snow, ice, standing or flowing water, loose particles, debris, and foreign matter shall have been removed. Earth foundations shall be satisfactorily compacted. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition. Spare vibrators shall be available. The entire preparation shall be accepted by the Government prior to placing.

3.1.2 Embedded Items

Reinforcement shall be secured in place; joints, anchors, and other embedded items shall have been positioned. Internal ties shall be arranged so that when the forms are removed all metal will be not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed.

3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. The form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. All exposed joints and edges shall be chamfered, unless otherwise indicated.

3.1.4 Vapor Barrier Installation

Vapor barriers shall be applied over gravel fill. Edges shall be lapped not less than 6 inches. All joints shall be sealed with pressure-sensitive adhesive not less than 2 inches wide. The vapor barrier shall be protected at all times to prevent injury or displacement prior to and during concrete placement.

3.1.5 Production of Concrete

3.1.5.1 Ready-Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94/C 94M, except as otherwise specified.
3.1.5.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C 685/C 685M.

3.1.5.3 Batching and Mixing Equipment

The Contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. On-site plant shall conform to the requirements of either ASTM C 94/C 94M or ASTM C 685/C 685M.

3.1.6 Waterstops

Waterstops shall be installed and spliced as directed by the manufacturer.

3.2 CONVEYING AND PLACING CONCRETE

3.2.1 General

Concrete placement shall not be permitted when, in the opinion of the Government Representative, weather conditions prevent proper placement, consolidation, and curing. When concrete is mixed and/or transported by a truck mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours or 45 minutes when the placing temperature is 85 degrees F or greater unless a retarding admixture is used. Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods, which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from agitating equipment. Concrete shall be deposited as close as possible to its final position in the forms and be so regulated that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. The placement shall be carried on at such a rate that the formation of cold joints will be prevented.

3.2.2 Consolidation

Each layer of concrete shall be consolidated by internal vibrating equipment. External vibrating equipment may be used when authorized by the Government Representative. Internal vibration shall be systematically accomplished by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. It shall be held stationary until there is a general cessation in escape of large bubbles of entrapped air in the surface of the concrete (generally 5 to 15 seconds) and then withdrawn slowly at the rate of about 3 inches per second.

3.2.3 Cold-Weather Requirements

No concrete placement shall be made when the ambient temperature is below 35 degrees F or if the ambient temperature is below 40 degrees F and falling. Suitable covering and other means, as approved by the Government Representative, shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after
placing and at a temperature above freezing for the remainder of the curing period. Salt, chemicals, or other foreign materials shall not be mixed with the concrete to prevent freezing. Any concrete damaged by freezing shall be removed and replaced at the expense of the Contractor.

3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 4.1 of ACI 308R, is expected to exceed 0.2 pounds per square foot per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

3.3 FORM REMOVAL

Forms shall not be removed before the expiration of 24 hours after concrete placement except where otherwise specifically authorized. Supporting forms and shoring shall not be removed until the concrete has cured for at least 5 days. When conditions on the work are such as to justify the requirement, forms will be required to remain in place for longer periods.

3.4 FINISHING

3.4.1 General

No finishing or repair shall be done when either the concrete or the ambient temperature is below 50 degrees F.

3.4.2 Finishing Formed Surfaces

All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

3.4.3 Finishing Unformed Surfaces

All unformed surfaces that are not to be covered by additional concrete or backfill shall be float finished to elevations shown on the drawings, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown on the drawings and left as a true and regular surface. Exterior surfaces shall be sloped for drainage unless otherwise shown on the drawings. Joints shall be carefully made with a jointing tool. Unformed surfaces shall be finished to a tolerance of 3/8 inch for a float finish and 5/16 inch for a trowel finish as determined by a 10 foot straightedge placed on surfaces shown on the plans to be level or having a constant slope. Finishing shall not be performed while there is excess moisture or bleeding water on the surface. No water or cement shall be added to the surface during
finishing.

3.4.3.1 Float Finish

Surfaces to be float finished shall be screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darbying or bullfloating shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete will support a person’s weight without more than about 1/4-inch indentation, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.4.3.2 Trowel Finish

Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Finished surfaces shall be protected from damage during the construction period.

3.4.3.3 Broom Finish

The concrete shall be screeded and floated to required finish plane with no coarse aggregate visible. After surface moisture disappears, the surface shall be broomed or brushed with a broom or fiber bristle brush in a direction transverse to that of the main traffic or as directed by the Government Representative.

3.4.3.4 Expansion and Contraction Joints

Expansion and contraction joints shall be made in accordance with the details shown on the drawings or as otherwise specified. Provide 1/2 inch thick transverse expansion joints where new work abuts an existing concrete. Expansion joints shall be provided at a maximum spacing of 30 feet on center in sidewalks and slabs, unless otherwise indicated. Contraction joints shall be provided at a maximum spacing of 6 linear feet in sidewalks and slabs, unless otherwise indicated.

3.5 CURING AND PROTECTION

Beginning immediately after placement and continuing for at least 7 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by any of the following methods:

(1) Continuous sprinkling or ponding.

(2) Application of absorptive mats or fabrics kept continuously wet (horizontal surfaces only).

(3) Application of sand kept continuously wet.

(4) Application of impervious sheet material.
(5) Application of membrane-forming curing compound in accordance with the manufacturer's written instructions.

The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for the required curing period. If forms are removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 25 degrees F within a 24-hour period.

3.6 GROUTING

3.6.1 General

After being plumbed and properly positioned, the base plate shall be grouted. Concrete surfaces shall be rough, clean, and free of oil, grease, and laitance, and they shall be damp. Curing compound shall have been mechanically removed from the concrete where grout is to be applied.

3.6.2 Nonshrink Grout

Unless recommended otherwise by the grout manufacturer, the mixture shall include by weight 1-1/2 parts of sound, clean, uncrushed gravel conforming to the size no. 8, Table 2, ASTM C 33 in combination with fine aggregate conforming to ASTM C 33, to 1 part portland cement. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.6.2.1 Mixing and Placing

Mixing and Placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry mixed before adding water. After adding water, the batch shall be mixed for at least 3 minutes. Batches shall be of a size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the pipe and retaining wall shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for retaining the grout and shall be removed after the grout has set. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.6.2.2 Treatment of Exposed Surfaces

Those types containing metallic aggregate shall have, after the grout has set, the exposed surfaces cut back 1 inch and immediately covered with a parge coat of mortar proportioned by weight of one part portland cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of nonshrink grout shall have a smooth, dense finish.

3.6.2.3 Curing

Grout and parge coats shall be cured in conformance with paragraph "CURING
AND PROTECTION”.

3.7 CONTRACTOR’S TESTS AND INSPECTIONS

3.7.1 General

The individuals who sample and test concrete as required in this
specification shall have demonstrated a knowledge and ability to perform
the necessary test procedures equivalent to the ACI minimum guidelines for
certification as a Concrete Field Testing Technician, Grade I.

3.7.2 Inspection Details and Frequency of Testing

3.7.2.1 Preparations for Placing

Foundation or construction joints, forms, and embedded items shall be
inspected in sufficient time prior to each concrete placement by the
Contractor to certify to the Government Representative that it is ready to
receive concrete.

3.7.2.2 Air Content

Air content shall be checked at least once during each shift that concrete
is placed. Samples shall be obtained in accordance with ASTM C 172 and
tested in accordance with ASTM C 231.

3.7.2.3 Slump

Slump shall be checked at least once during each shift that concrete is
produced. Samples shall be obtained in accordance with ASTM C 172 and
tested in accordance with ASTM C 143/C 143M.

3.7.2.4 Consolidation and Protection

The Contractor shall ensure that the concrete is properly consolidated,
finished, protected, and cured.

3.7.3 Action Required

3.7.3.1 Placing

The placing foreman shall not permit placing to begin until he/she has
verified that an adequate number of acceptable vibrators, which are in
working order and have competent operators, are available. Placing shall
not be continued if any pile of concrete is inadequately consolidated.

3.7.3.2 Air Content

Whenever a test result is outside the specification limits, the concrete
shall not be delivered to the forms and an adjustment shall be made to the
dosage of the air entrainment admixture.

3.7.3.3 Slump

Whenever a test result is outside the specification limits, the concrete
shall not be delivered to the forms and an adjustment should be made in the
batch weights of water and fine aggregate. The adjustments are to be
made so that the water-cementitious materials ratio does not exceed that
contained in the approved concrete mixture proportions.
3.7.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered to the Government Representative within 3 days after the end of each weekly reporting period. See Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL. The Government has the right to examine all Contractor quality control records.

-- End of Section --
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DIVISION 03 - CONCRETE

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CAST-IN-PLACE STRUCTURAL CONCRETE

08/10

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PART 1    GENERAL

1.1    SCOPE

The work covered by this section consists of furnishing all plant, labor, materials, and performing all operations in connection with furnishing and placing cast-in-place concrete for construction of box culverts, U-channels, head walls, wingwalls, foundations, slabs, head works structure, pump station structure and other components incidental thereto as shown on plans and as specified herein.

1.2    MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3    RELATED WORK SPECIFIED ELSEWHERE

a.  Section 03 15 13.00 12 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

b.  Section 03 21 00.00 12 REINFORCING STEEL.

c.  Section 03 11 14.00 12 FORMWORK FOR CONCRETE.

1.4    REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117 (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary


ACI 214R (2011) Evaluation of Strength Test Results of Concrete

ACI 302 (2004; Errata 2006; Errata 2007) Guide for Concrete Floor and Slab Construction


ACI 318/318R (2009) Building Code Requirements for Structural Concrete and Commentary
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<th>ASTM Standard Code</th>
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<td>ASTM C231</td>
<td>(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method</td>
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Concrete


ASTM C597  (2009) Pulse Velocity Through Concrete

ASTM C618  (2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C803  (2003; R 2010) Penetration Resistance of Hardened Concrete

ASTM C805  (2008) Rebound Number of Hardened Concrete


Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete Mixture Proportions; G

Concrete mixture proportions shall be determined by the Contractor, in accordance with the requirements in paragraph "CONCRETE MIXTURE PROPORTIONING", and submitted for approval. The concrete mixture quantities of all ingredients per cubic yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan, and ground
granulated blast-furnace (GGBF) slag when used, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C1077, which show that proportions thus selected will produce concrete of the qualities indicated. The submission shall provide information specified in paragraph "Documenting Average Strength", and if applicable, paragraph "Determining Standard Deviation". Mix proportions, exact slump and exact air content shall be reported for each concrete cylinder used to develop the mix design. For concrete that is to be deposited underwater, the exact amount of washout determined for each trial mixture including the submitted mixture proportions shall also be reported. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

Aggregates; G

Information identifying the aggregate source to be used along with gradation tests for fine and coarse aggregates shall be submitted for approval. The gradation test for fine aggregate shall include the No. 8 and No. 30 sieve sizes. Actual current gradation tests (not average) shall be submitted. Specific gravity and absorption of fine and coarse aggregates determined by ASTM C128 and ASTM C127, respectively shall also be submitted.

Batch Plant

The Contractor shall submit batch plant data to the Government Representative for review for conformance with paragraphs "Capacity" and "Batch Plant."

Concrete Mixers

The Contractor shall submit concrete mixer data, which includes the make, type, and capacity of concrete mixers for review of conformance with paragraphs "Capacity" and "Concrete Mixers."

Conveying Equipment and Methods

The conveying equipment and methods for transporting, handling, and depositing the concrete shall be submitted for review for conformance with paragraphs "Capacity" and "Conveying Equipment."

Placing Equipment and Methods

All placing equipment and methods shall be submitted for review for conformance with paragraphs "Capacity" and "Placing Equipment and Methods."

Nonshrink Grout

Descriptive literature of the nonshrink grout proposed for use indicating conformance with the specification requirements shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered or the Contractor shall submit the application and exposure where the grout is to be used and shall
submit manufacturer's literature indicating that the grout is appropriate for the application and exposure and meets all specification requirements.

Anti-Washout Admixture

Manufacturer's written literature showing compliance with all specification requirements shall be submitted for approval.

SD-04 Samples

Aggregate; G

Samples of materials for Government testing and approval shall be submitted as required in paragraph "Aggregates."

Surface Retarder

Sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

SD-05 Design Data

Construction Joint Treatment; G

The method and equipment proposed for construction joint preparation and waste disposal shall be submitted for review for conformance with paragraph "Construction Joint Treatment."

Curing and Protection; G

The curing medium and methods to be used shall be submitted for review for conformance with paragraph "CURING AND PROTECTION."

Cold-Weather Placing; G

If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection shall be submitted for review for conformance with paragraph "Cold-Weather Placing."

Hot-Weather Placing; G

If concrete is to be placed under hot-weather conditions, the proposed materials and methods, meeting the requirements of paragraph "Hot-Weather Placing" and paragraph "FINISHING," shall be submitted for review.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

Uniformity of Concrete Mixing
The results of the initial mixer uniformity tests as required in paragraph "Uniformity of Concrete Mixing" shall be submitted at least five (5) days prior to the initiation of placing. The initial test results submitted shall not be more than three months old. Additional tests shall be conducted and submitted within six months of the previous tests. Uniformity testing shall continue until all concrete is placed.

Tests and Inspections

Test results and inspection reports shall be submitted daily and weekly as required in paragraph "Reports."

SD-07 Certificates

Qualifications

The Contractor shall submit statements that the concrete testing technicians and the concrete construction special inspector meet the qualification requirements of paragraph "Testing and Inspection for Contractor Quality Control".

Cementitious Materials; G

Cementitious materials will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports, stating that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. If average values are submitted, they shall be furnished with daily test results. If a blended product meeting ASTM C595 is to be used, the manufacturer shall also certify in writing that the amount of pozzolan or slag in the finished cement will not vary more than plus or minus 5.0 mass percent of the finished cement from lot to lot or within a lot. No cementitious materials shall be used until notice of acceptance has been given by the Government Representative. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Government Representative, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

Impervious-Sheet Curing Materials

Impervious-sheet curing materials shall be certified for compliance with all specification requirements.

Air-Entraining Admixture

Air-entraining admixture shall be certified for compliance with all specification requirements.

Other Chemical Admixtures

Other chemical admixtures shall be certified for compliance with all specification requirements.
Membrane-Forming Curing Compound

Membrane-forming curing compound shall be certified for compliance with all specification requirements.

Latex Bonding Compound

Latex bonding compound shall be certified for compliance with all specification requirements.

1.6 GOVERNMENT TESTING AND SAMPLING

The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples of aggregates and concrete. Concrete and aggregate requirements in this paragraph and its subparagraphs do not relieve the Contractor of the requirements outlined in paragraph "TESTS AND INSPECTIONS."

1.6.1 Aggregate

The aggregate shall be from a Government approved source capable of producing materials of a quality acceptable for this project provided suitable processing was performed. If the Contractor proposes to furnish aggregates from a source not approved by Government, samples of aggregate taken under the supervision of the Government Representative shall be delivered to the Government approved testing laboratory within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. The cost of testing one source for each size aggregate will be borne by the Government. If the Contractor selects more than one source for each aggregate size or selects a substitute source for any size aggregate after the original source was tested, the cost of that additional testing will be borne by the Contractor. From 90 to 120 days will be required to complete evaluation of the aggregates. Testing will be in accordance with applicable ASTM test methods. Tests to which aggregate may be subjected are specific gravity, absorption, cycles of freezing and thawing in concrete, alkali aggregate reaction and organic impurities.

1.6.2 Concrete

The Government will determine when concrete shall be sampled. The Contractor shall cast, protect and deliver concrete cylinders and determine slump and air content. The person conducting the tests shall meet the Concrete Field Testing Technician requirements contained in paragraph "General." Concrete shall be sampled in accordance with ASTM C172. When cylinders are molded, slump and air content shall be determined in accordance with ASTM C143 and ASTM C231, respectively. Test samples for each class of concrete shall be taken at least once every 8-hour shift or for every 150 cubic yards placed, whichever requires more samples. From each sample, three 6-inch by 12-inch compression test specimens shall be made in accordance with ASTM C31. Compression test specimens shall be cured while in the field in accordance with paragraphs 10.1, 10.1.1 and 10.1.2 of ASTM C31. If cylinders are not delivered to the testing laboratory within 24 to 48 hours after molding, they shall be submerged in a water tank provided by the Contractor, where the surrounding water temperature is maintained by the Contractor at 73.4 plus or minus 3 degrees F. Cylinders shall be transported in accordance with ASTM C31 (with cushioning material) and unloaded in the Government designated location. Compression testing will be performed by the
Government in accordance with ASTM C39. One cylinder will be tested at seven (7) days for information and two (2) cylinders will be tested at the specified design age for acceptance.

1.6.3 Concrete Strength

Compressive strength test specimens required in paragraph "Concrete" will be used to determine compliance. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength $f'_c$ and no individual test result falls below the specified strength $f'_c$ by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including nondestructive testing, taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

1.6.3.1 Investigation of Low-Strength Test Results

When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C597, ASTM C803, or ASTM C805 may be permitted by the Government Representative to estimate the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.

1.6.3.2 Testing of Cores

When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Government Representative to least impair the performance of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.

1.6.3.3 Load Tests

If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Government Representative in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test shall be corrected in a manner satisfactory to the Government Representative. All investigations, testing, load tests, and correction of deficiencies will be performed and approved by the Government Representative at the expense of the Contractor, except that if all concrete is in compliance with the plans and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.
1.6.4  Cement and Pozzolan

If cement or pozzolan is to be obtained from more than one (1) source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

1.6.4.1  Cement Sources

Cement will be sampled at the source and stored in sealed bins pending completion of testing. Sampling, testing, and the shipping inspection from the point of sampling, when the point is other than at the site of the work, will be made by or under the supervision of the Government and at its expense. No cement shall be used until notice has been given by the Government Representative that test results are satisfactory. In the event of failure, the cement may be resampled and tested at the request of the Contractor, at his expense. When the point of sampling is other than at the site of the work, the fill gates of the sampled bin and conveyances used in shipment will be sealed under Government supervision and kept sealed until shipment from the bin has been completed. If tested cement is rehandled at transfer points, the extra cost of inspection shall be at the Contractor's expense.

1.6.4.2  Pozzolan Sources

Pozzolan will be sampled at the source and stored in sealed bins pending completion of certain tests. Pozzolan will also be sampled at the site when determined necessary. All sampling and testing will be by and at the expense of the Government. Release for shipment and approval for use will be based on compliance with 7-day lime-pozzolan strength requirements and other physical and chemical and uniformity requirements for which tests can be completed by the time the 7-day lime-pozzolan strength test is completed. Release for shipment and approval for use on the above basis will be contingent on continuing compliance with the other requirements of the specifications. If a bin fails, the contents may be resampled and tested at the Contractor's expense. In this event the pozzolan may be sampled as it is loaded into cars, trucks, or barges provided they are kept at the source until released for shipment. Unsealing and resealing of bins and sealing of shipping conveyances will be done by or under the supervision of the Government. Shipping conveyances will not be accepted at the site of the work unless received with all seals intact. If pozzolan is damaged in shipment, handling, or storage, it shall be promptly removed from the site of the work. Pozzolan that has not been used within six (6) months after testing shall be retested at the expense of the Contractor when directed by the Government Representative and shall be rejected if the test results are not satisfactory. If tested pozzolan is rehandled at transfer points, the extra cost of inspection shall be at the Contractor's expense.

1.7  DESIGN REQUIREMENTS

1.7.1  Concrete Strength

Specified compressive strength $f'_c$ shall be as follows:

<table>
<thead>
<tr>
<th>Compressive Strength (PSI) at Design Age</th>
<th>Structure Or Portion Of Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000 @ 28 days</td>
<td>Prestressed Precast Concrete</td>
</tr>
</tbody>
</table>
Piles
4,000 @ 28 days

2,500 @ 28 days
* 90 days if pozzolan is used.

1.7.2 Maximum Water-Cementitious Materials (W/CM) Ratio

Maximum W/CM shall be as follows:

<table>
<thead>
<tr>
<th>W/CM, By Mass</th>
<th>Structure Or Portion Of Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>Box culverts, headwork structure, wing walls, intake structures, foundation slabs, building roof and walls</td>
</tr>
<tr>
<td>0.45</td>
<td>Precast Prestressed Concrete Piles</td>
</tr>
<tr>
<td>0.60</td>
<td>Stabilization Slab</td>
</tr>
</tbody>
</table>

1.8 CONSTRUCTION TOLERANCES

1.8.1 General

The definitions of the terms used in the following tables shall be as defined in ACI 117. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance controls. Tolerances shall not extend the structure beyond legal boundaries. Except as specified otherwise, plus tolerance increases the amount or dimension to which it applies, or raises a level alignment, and minus tolerance decreases the amount or dimension to which it applied, or lowers a level alignment. A tolerance without a sign means plus or minus. Where only one (1) signed tolerance is specified, there is no limit in the other direction.

TOLERANCES FOR FOUNDATIONS

(1) Lateral alignment

Eccentricity measured from the center of gravity of footing as cast to the center of gravity as specified; 0.02 times width of footing in direction of misplacement but not more than ............................. 2 inch

Supporting masonry construction .............................. 1/2 inch

(2) Level alignment

Top of footings supporting masonry .......................... 1/2 inch

Top of other footings ................................. plus 1/2 inch

minus 2 inch

(3) Cross-sectional dimensions

Horizontal dimension of formed members ..................... plus 2 inch
Horizontal dimensions of unformed members cast against soil

- 2 feet or less .................................................. plus 3 inch
- Greater than 2 feet but less than 6 feet .................. plus 6 inch
- Over 6 feet .................................................. plus 12 inch

Vertical dimension (thickness) ...................... minus 5 percent

(4) Relative alignment

Slope of footing side and top surfaces with respect to the specified plane .............................. 1 inch max. per 10 feet

TOLERANCES FOR CAST-IN-PLACE REINFORCED CONCRETE FOR BUILDINGS

(1) Vertical alignment

For heights 100 ft or less

- Lines, surfaces, and arrises .......................... 1 inch

Outside corner of exposed corner columns and control joint grooves in concrete exposed to view .............................. 1/2 inch

(2) Lateral alignment

Members .......................................................... 1 inch

- In slabs, centerline location of openings 12 in. or smaller and edge location of larger openings ..................... 1/2 inch

Sawcuts, joints, and weakened plane embedment in slabs ........................................ 3/4 inch

(3) Level alignment

Top of slabs

- Elevation of slabs-on-grade ............................. 3/4 inch

Elevation of top surfaces of formed slabs before removal of supporting shores .................... 3/4 inch

Elevation of formed surfaces
before removal of shores ................................. 3/4 inch

Lintels, sills, parapets, horizontal grooves, and other lines
lines exposed to view .................................... 1/2 inch

(4) Cross-sectional dimensions
Members, such as columns, beams, piers, walls (thickness only), and slabs (thickness only)

12-in. dimension or less ................................. plus 3/8 inch
................................. minus 1/4 inch

More than 12 inches but not over 3 feet dimension ................................. plus 1/2 inch
................................. minus 3/8 inch

Over 3-ft dimension ................................. plus 1 inch
................................. minus 3/4 inch

(5) Relative alignment

Stairs
Different in height between adjacent risers ................................. 1/8 inch

Different in width between adjacent treads ................................. 1/4 inch

Grooves
Specified width 2 inches or less ................................. 1/8 inch

Specified width more than 2 inches but not more than 12 in ................................. 1/4 inch

Sawcuts, joints, and weakened plane on slab
Lateral, gradual ................................. 3/4 inch in 10 feet
Lateral, abrupt ................................. 0 inch

(6) Openings through members

Cross-sectional size of opening ................................. minus 1/4 inch
................................. plus 1 inch

Location of centerline of opening ................................. 1/2 inch

TOLERANCE FOR FORMED CONCRETE SURFACES

(1) Vertical alignment

Formed surfaces slope with respect to the specified plane

Vertical alignment of outside corner of exposed corner
columns and control joint grooves in concrete exposed to view .... 1/4 inch max. in 10 feet

All other conditions ....................... 3/8 inch max. in 10 feet

(2) Abrupt variation
The offset between concrete surfaces for the following classes of surface: ................................................ minus 1/8 inch
(For Class AHV, positive means raise of elevation in the direction of water flow, negative means drop of elevation in the direction of water flow)

*Class AHV, in the direction of water flow ........ plus 0 inch

perpendicular to the direction of water flow ........ 1/8 inch

Class A ................................................... 1/8 inch
Class B .................................................. 1/4 inch
Class C ................................................. 1/2 inch
Class D .................................................. 1 inch

(3) Gradual variation
Surface finish tolerances as measured by placing a freestanding (unleveled), 5-feet straightedge for plane surface or curved template for curved surface anywhere on the surface and allowing it to rest upon two high spots within 72 hours after concrete placement. The gap at any point between the straightedge or template and the surface shall not exceed:

*Class A (including Class AHV) .......................... 1/8 inch
Class B ................................................. 1/4 inch
Class C ................................................. 1/2 inch
Class D .................................................. 1 inch

*Includes any high-velocity (greater than 40 fps) water flow on any surface.

(1) Lateral alignment
Centerline alignment

Culverts ............................................. 1/2 inch

Inside dimensions ......................... 0.005 times inside dimension

(2) Level alignment
Profile grade
Culverts ................................................. 1/2 inch
Surface of invert ................................. 1/4 inch
Surface of side slope ............................. 1/2 inch
(3) Cross-sectional dimension

Thickness at any point
Culvert lining .............................. minus 0 inch

1.8.2 Tolerance for Floors by the F-Number System

The flatness and levelness of the floors in the following listed areas shall be carefully controlled and the tolerances shall be measured in accordance with ACI 117 and ACI 302.

The Contractor shall furnish a floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number, in accordance with ASTM E1155. The Contractor shall perform the tolerance measurements while being observed by the Government Representative. The tolerance requirement will be FF50/FL33. Special finishing procedures and special care will be required to meet these tolerances.

1.8.3 Tolerance for Floors by Straightedge Measurement

Floor finish tolerances shall be measured by placing a free-standing (unleveled) 10 foot straightedge anywhere on the slab and allowing it to rest upon two high spots. The measurements shall be taken within 72 hours after slab concrete placement. The gap at any point between the straightedge and the floor shall not exceed:

Floated surface .............................. 1/2 inch
Flat surface ................................. 3/16 inch
Very flat surface .............................. 1/8 inch

1.8.4 Appearance

Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method that does not harm the concrete and that is approved by the Government Representative.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall be portland cement, portland-pozzolan cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in architectural concrete shall be restricted to one color, one source, and one type.
2.1.1.1  Portland Cement

ASTM C150, low alkali, Type I or II, except that the maximum amount of $C_3A$ in Type I cement shall be 15 percent and cement with a Blaine Fineness of 400 square meters per kilogram or greater shall be considered Type III cement.

2.1.1.2  High-Early-Strength Portland Cement

ASTM C150, Type III, low alkali, with $C_3A$ limited to 5 percent used only when specifically approved in writing.

2.1.1.3  Pozzolan, Other than Silica Fume

Pozzolan shall conform to ASTM C618, Class C, with the Effectiveness in Controlling Alkali-Silica Reaction requirements of Table 3. Test results showing that the proposed combination of cementitious materials and aggregates will expand less than 0.10 percent in 16 days when tested in accordance with ASTM C1567 may be substituted for the Effectiveness in Controlling Alkali-Silica Reaction test.

2.1.1.4  Ground Granulated Blast-Furnace Slag

Ground Granulated Blast-Furnace Slag (GGBF) shall conform to ASTM C989, Grade 100 or Grade 120.

2.1.1.5  Blended Hydraulic Cement

Blended hydraulic cement shall meet the mortar expansion limits found in Table 2 of ASTM C595. Admixture additions shall not be included in the blended cement.

2.1.2  Aggregates

Concrete aggregate shall be produced from the same sources. Fine and coarse aggregates shall conform to the grading requirements of ASTM C33 or LSSRB 1003.02. The quality of all aggregates shall conform to ASTM C33. The nominal maximum size shall be as listed in paragraph "Nominal Maximum-Size Coarse Aggregate."

2.1.3  Chemical Admixtures

Chemical admixtures to be used, when required or permitted, shall conform to the appropriate specification listed.

2.1.3.1  Air-Entraining Admixture

The air-entraining admixture shall conform to ASTM C260 and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

2.1.3.2  Accelerating Admixture

Accelerators shall meet the requirements of ASTM C494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.
2.1.3.3 Water-Reducing or Retarding Admixture

Water-Reducing or Retarding Admixtures: ASTM C494, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

High-Range Water Reducing Admixture: ASTM C494, Type F or G, except that the 6-month and 1-year strength requirements shall be waived. The admixture may be used only when approved by the Government Representative, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan.

2.1.3.4 Other Chemical Admixtures

Other chemical admixtures for use in producing flowing concrete shall comply with ASTM C1017, Type 1 or 2.

2.1.3.5 Anti-Washout Admixture

Anti-washout admixture shall be RHEOMAC UW 450 as manufactured by Master Builders, Inc, EUCON AWA as manufactured by Euclid Chemical Company, Sikament 100SC as manufactured by Sika Corporation, or an approved equal.

2.1.4 Curing Materials

2.1.4.1 Impervious-Sheet Curing Materials

Impervious-sheet curing materials shall conform to ASTM C171, type optional, except polyethylene film shall not be used.

2.1.4.2 Membrane-Forming Curing Compound

The membrane-forming curing compound shall conform to ASTM C309, Type 1-D or 2.

2.1.4.3 Burlap

Burlap used for curing shall conform to CCC-C-467.

2.1.5 Water

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, sugar, or alkali, except that nonpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.6 Nonshrink Grout

Nonshrink grout shall conform to ASTM C1107 and shall be a commercial formulation suitable for the application proposed.

2.1.7 Latex Bonding Compound

Latex bonding compound agents for bonding fresh to hardened concrete shall conform to ASTM C1059.

2.2 Concrete Mixture Proportions

2.2.1 Quality of Mixture

For each portion of the structure, mixture proportions shall be selected...
so that the strength and W/CM requirements listed in paragraph "DESIGN REQUIREMENTS" are met.

2.2.2 Nominal Maximum-Size Coarse Aggregate

Nominal maximum-size coarse aggregate shall be 1-1/2 inches or 1 inch except 3/4 inch nominal maximum-size coarse aggregate shall be used when any of the following conditions exist: the narrowest dimension between sides of forms is less than 7-1/2 inches; the depth of the slab is less than 4 inches; the minimum clear spacing between reinforcing and sheet piling is less than 2-1/4 inches; or the minimum clear spacing between reinforcing is less than 2-1/4 inches.

2.2.3 Air Content

Air content as delivered to the forms and as determined by ASTM C231 shall range from 3 to 7 percent except that when the nominal maximum-size coarse aggregate is 3/4 inch, it shall range from 3-1/2 to 7-1/2 percent.

2.2.4 Slump

The slump shall be determined in accordance with ASTM C143 and shall range from 1 to 4 inches. Where placement by pump is approved, the slump shall range from 3 to 6 inches.

2.2.5 Pozzolan Content

If pozzolan is used, it shall range from 15 to 35 percent by weight of the total cementitious materials.

2.2.6 Determining Standard Deviation

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall:

(1) represent materials, quality control procedures, and conditions similar to those expected at the proposed work;

(2) not be from a project where the allowable changes in materials and/or proportions were more restricted than for the proposed work;

(3) represent concrete produced to meet a specified strength or strengths, $f'_{c}$, within 1000 psi of that specified for the proposed work;

(4) be from consecutive tests;

(5) be from different batches;

(6) be the average of strengths from two cylinders made from the same sample of concrete and tested at the age indicated in paragraph "Concrete Strength" and

(7) be from concrete that was produced within one year of the time when concrete placement is expected to begin for the proposed work.
2.2.6.1 For 30 or More Test Records

Use an unmodified standard deviation and calculate for $f_{cr}$ as specified in paragraph "For 15 or More Test Records."

2.2.6.2 For 15 to 29 Test Records

Where a concrete production facility does not have 30 test records, but does have a record based on 15 to 29 consecutive tests, a modified standard deviation may be established as the product of the standard deviation based on 15 to 29 tests and modification factor from the following table. Calculate $f_{cr}$ as specified in paragraph "For 15 or More Test Records."

<table>
<thead>
<tr>
<th>Number of Records</th>
<th>Modification Factor for Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>1.16</td>
</tr>
<tr>
<td>20</td>
<td>1.08</td>
</tr>
<tr>
<td>25</td>
<td>1.03</td>
</tr>
<tr>
<td>30 or more</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Interpolate for intermediate numbers of records.

2.2.6.3 For Less Than 15 Test Records

No standard deviation is needed. Calculation of $f_{cr}$ shall be as specified in paragraph "For Less Than 15 Test Records."

2.2.7 Required Average Compressive Strength, $f_{cr}$

In meeting the strength requirements specified in paragraph "Concrete Strength," the selected mixture shall have proportions so as to produce an $f_{cr}$ exceeding $f'_c$ as indicated in subparagraphs "For 15 or More Test Records" or "For less than 15 Test Records."

2.2.7.1 For 15 or More Test Records

If a standard deviation is calculated as specified in paragraph "Determining Standard Deviation," $f'_c$ shall be determined based on the value of $f'_c$ and the standard deviation, $S$, as follows:

<table>
<thead>
<tr>
<th>Standard Deviation, $S$</th>
<th>Required Average Compressive Strength, $f_{cr}$ (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than or equal to 505</td>
<td>$f'_c + 1.34 S$</td>
</tr>
<tr>
<td>Greater than 505</td>
<td>$f'_c + 2.33 S-500$</td>
</tr>
</tbody>
</table>

2.2.7.2 For less than 15 Test Records

When a concrete production facility does not have field strength test records for calculation of standard deviation, $f_{cr}$ shall be determined based on the value of $f'_c$ as follows:

<table>
<thead>
<tr>
<th>Specified Compressive Strength, $f'_c$ (psi)</th>
<th>Required Average Compressive Strength, $f_{cr}$ (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3000</td>
<td>$f'_c + 1000$</td>
</tr>
<tr>
<td>3000-5000</td>
<td>$f'_c + 1200$</td>
</tr>
</tbody>
</table>
2.2.8 Documenting Average Strength

Documentation that proposed concrete proportions produce the required average strength, $f'_{cr}$, determined in paragraph "Required Average Compressive Strength, $f'_{cr}$" shall be based on previous field experience (paragraph "Field Experience") or laboratory trial batches (paragraph "Laboratory Trial Batches"). Documentation shall include compression, slump and air content tests performed on concrete produced using the proposed mixture proportions.

2.2.8.1 Field Experience

Required average strength can be documented by field experience if compressive strength test records consisting of not less than 10 consecutive tests and encompassing a period of not less than 60 days are used. Test records shall represent similar materials to those proposed and similar conditions to those expected. Changes in materials, conditions, and proportions within the test record shall not have been more closely restricted than those for the proposed work.

2.2.8.2 Laboratory Trial Batches

The laboratory used to develop information required by this section shall comply with ASTM C1077.

a. Delivery of Samples

Representative samples for all concrete materials proposed for this project and a copy of this section of the contract specifications entitled "CAST IN PLACE STRUCTURAL CONCRETE" shall be delivered to the laboratory that performs the concrete proportioning at least 60 days (120 when pozzolan is used) before concrete placement is expected to begin. Samples of approved aggregates shall be obtained in accordance with the requirements of ASTM D75. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by manufacturer's test reports indicating compliance with applicable specification requirements. When all of these materials have been delivered, the name, address, and phone number of this laboratory and a list of the sources and types of all concrete materials shall be submitted to the Government Representative.

b. Trial Mixtures

Trial mixtures having proportions, consistencies, maximum slump and maximum air content suitable for the work shall be made based on ACI 211.1, using at least three different water/cementitious materials ratios which will produce a range of strengths encompassing those required for the work. The trial mixtures shall have a slump and air content within plus or minus 3/4 inch and plus or minus 0.5 percent, respectively, of the maximum permitted. The target water/cementitious materials ratios required in paragraph "Maximum Water-Cement (W/C) Ratio" include the total weight of cement plus pozzolan and GGBF slag, converted from absolute volume as described in ACI 211.1. Trial mixtures shall be designed in accordance with the procedure in ACI 211.1,
Chapter 6, using the absolute volume basis for determining the required amount of fine aggregate. The dry rodded weight per cubic foot of the coarse aggregate determined according to ASTM C29; the fineness modulus of the fine aggregate determined according to COE CRD-C 104; and the yield, slump and air content shall be reported. For each water cementitious materials ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C192. The cylinders shall be tested in accordance with ASTM C39 at 7 and 28 days (also 90 if pozzolans or GGBF slag is used). From these test results a curve shall be plotted and submitted showing the relationship between water cementitious materials ratio and strength at design age.

PART 3   EXECUTION

3.1   EQUIPMENT

3.1.1   Capacity

The batching, mixing, conveying, and placing equipment shall have a capacity of at least 30 cubic yards per hour.

3.1.2   Batch Plant

Batch plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.1.2.1   Batching Equipment

The batching controls shall be semiautomatic. The semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with an accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. Separate bins or compartments shall be provided for each size group of aggregate and cementitious material. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both cement and other cementitious materials are used, they may be batched cumulatively provided that the portland cement is batched first. If measured by mass, the mass of the water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Admixtures shall not be combined prior to introduction in water. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment. All filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.
3.1.2.2 Scales

The equipment for batching by mass shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. Tests shall be made at the frequency required in paragraph "TESTS AND INSPECTIONS," and in the presence of a government inspector.

3.1.2.3 Batching Tolerances

a. Weighing Tolerances

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>PERCENT OF REQUIRED MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cementitious materials</td>
<td>0 to plus 2</td>
</tr>
<tr>
<td>Aggregate</td>
<td>plus or minus 2</td>
</tr>
<tr>
<td>Water</td>
<td>plus or minus 1</td>
</tr>
<tr>
<td>Chemical admixture</td>
<td>0 to plus 6</td>
</tr>
</tbody>
</table>

b. Volumetric Tolerances - For volumetric batching equipment, the following tolerances shall apply to the required volume of material being batched:

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Plus or minus 1 percent.</td>
</tr>
<tr>
<td>Chemical admixtures</td>
<td>Zero to plus 6 percent.</td>
</tr>
</tbody>
</table>

3.1.2.4 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the masses of the materials being batched.

3.1.3 Concrete Mixers

The concrete mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.1.3.1 Stationary Mixers

Concrete plant mixers shall be tilting, nontilting, horizontal-shaft, vertical-shaft, or pugmill and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C94 applicable to central-mixed concrete.

3.1.3.2 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped
with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

3.1.4 Conveying Equipment and Methods

The conveying equipment shall conform to the following requirements.

3.1.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.1.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.1.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C94. Nonagitating equipment may be used for transporting plant-mixed concrete over a smooth road when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.1.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Government Representative. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.1.4.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is
to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant trunk that is long enough to extend through the reinforcing bars.

3.1.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.1.4.7 Tremie Equipment

Funnel-shaped hoppers of sufficient volume shall be required at the top of all tremie pipes, but shall not be less than two (2) cubic yards. Aluminum pipe or equipment shall not be used for placing concrete. The tremie pipe for underwater concrete shall have a diameter of 8 to 12 inches to permit a free flow of concrete. Tremie pipes shall be made of steel and have watertight joints. Hoisting equipment for raising and lowering tremie pipes as the concrete is placed and tools for connecting the pipe sections shall be continuously available and on hand. Each section of tremie pipe shall be suitably secured together and a gasket used at each joint to prevent leakage. The tremie pipe shall be marked to allow quick determination of the distance from the surface of the water to the mouth of the tremie. A stable platform shall be provided to the tremie pipe during placements. The platform shall be capable of supporting the tremie while sections are being removed from the upper end of the tremie. A dry pipe with a plate and gasket wired to the bottom to prevent contact of the concrete and the water in the pipe shall be required to start each placement. Go-devils or similar devices are not permitted.

3.1.5 Vibrators

Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

<table>
<thead>
<tr>
<th>Application</th>
<th>Head Diameter</th>
<th>Frequency</th>
<th>Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin walls, beams, etc.</td>
<td>1-1/4 to 2-1/2</td>
<td>9,000 to 13,500</td>
<td>0.02 to 0.04</td>
</tr>
<tr>
<td>General construction</td>
<td>2 to 3-1/2</td>
<td>8,000 to 12,000</td>
<td>0.025 to 0.05</td>
</tr>
</tbody>
</table>

The frequency and amplitude shall be determined in accordance with COE CRD-C 521.

3.2 PREPARATION FOR PLACING

3.2.1 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall
be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding, including tack welding, will not be permitted on embedded metals within 2 feet of the surface of the concrete.

3.2.2 Concrete on Earth Foundations

Earth surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the earth foundation shall have been satisfactorily compacted in accordance with SECTION 31 23 16.16 12 STRUCTURAL EXCAVATION AND BACKFILL.

3.2.3 Construction Joint Treatment

Construction joint treatment shall conform to the following requirements.

3.2.3.1 Joint Preparation

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by ensuring that the surface is roughened to an amplitude of 1/4 inch by either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Air-water cutting will not be permitted on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean, well-bonded coarse aggregate is exposed uniformly throughout the lift surface. The edges of the coarse aggregate shall not be undercut. The surface shall be washed clean as the last operation prior to placing the next lift. There shall be no standing water on the surface upon which concrete is placed.

3.2.3.2 Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 90 to 110 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Government Representative, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish samples of the material to be used and shall demonstrate the method to be used in applications. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure water jet or sandblasting will be required as the last operation before placing the next lift.

3.2.3.3 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi may be used for construction joint preparation. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin of mortar is removed and there is no undercutting of coarse-aggregate particles. If the water jet is incapable of uniformly exposing coarse aggregate, the surface shall be prepared by sandblasting.
3.2.3.4 Wet Sandblasting

This method may be used when the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. The surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.2.3.5 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.3 Placing Equipment and Methods

3.3.1 Placing Procedures

The surfaces of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24 hour period prior to placing concrete. The surfaces shall be at a saturated surface dry (SSD) condition at the time of concrete placement. Surfaces may be dampened immediately before placement if necessary. Concrete placement will not be permitted when, in the opinion of the Government Representative, weather conditions prevent proper placement and consolidation. Concrete shall be deposited as close as possible to its final position in the forms and, in so depositing, there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it may be effectively consolidated in horizontal layers 2 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed. Concrete shall be placed by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper that is conical in shape. The concrete shall not be dropped vertically more than 5 feet, except where a properly designed and sized elephant trunk with rigid drop chute bottom section is provided to prevent segregation and where specifically authorized. In no case will concrete be discharged to free-fall through reinforcing bars.

3.3.2 Placement by Pump

When concrete is to be placed by pump, the nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms. Grout used to lubricate the pumping equipment at the beginning of the placement shall not be incorporated into the placement.

3.3.3 Time Interval Between Mixing and Placing

Concrete shall be placed within 30 minutes after discharge into
nonagitating equipment. When concrete is truck-mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work, and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregates. When the length of haul makes it impossible to deliver truck-mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site.

3.3.4 Cold-Weather Placing

When cold-weather placing of concrete is likely to be subjected to freezing temperatures before the expiration of the curing period, it shall be placed in accordance with procedures previously submitted in accordance with paragraph "SUBMITTALS." The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32 degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 and 75 degrees F when measured in accordance with ASTM C1064. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete-placing temperatures. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be mixed with the concrete to prevent freezing.

3.3.5 Hot-Weather Placing

Concrete shall be properly placed and finished with procedures previously submitted in accordance with paragraph "SUBMITTALS." The concrete-placing temperature shall not exceed 90 degrees F when measured in accordance with ASTM C1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder shall be used to facilitate placing and finishing when concrete temperatures exceed 85 degrees F. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

3.3.6 Consolidation

Immediately after placement, each layer of concrete, including flowing concrete, shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required, if necessary, with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used unless specifically approved. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding unhardened layer if such exists. It shall be held stationary until there is a general cessation in escape of large bubbles of entrapped air at the surface of the concrete (generally 5 to 15 seconds) then withdrawn slowly at about 3 inches per second.

3.4 FINISHING

The ambient temperature of spaces adjacent to surfaces being finished
shall be not less than 40 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour, provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish. Additional finishing shall be as specified below and shall be true to the elevation shown in the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or jitterbugs shall not be used.

3.4.1 Unformed Surfaces

3.4.1.1 Float Finish

Surfaces shall be screeded and darbied or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. The concrete, while still green but sufficiently hardened to bear a man's weight without more than about a 1/4 inch indentation, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be made of magnesium or aluminum.

3.4.1.2 Trowel Finish

A trowel finish shall be applied to all unexposed surfaces. Concrete surfaces shall be finished with a float finish, and after surface moisture has disappeared, the surface shall be troweled to a smooth, even, dense finish free from blemishes including trowel marks.

3.4.1.3 Broom Finish

A broom finish shall be applied to all exposed surfaces. The concrete surface shall be finished with a float finish. The floated surface shall be broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

3.4.2 Formed Surfaces

Unless another finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired as described in paragraph "Formed Surface Repair."

Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, corners, and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.
3.4.3 Formed Surface Repair

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

3.4.3.1 Class A Finish

Surfaces listed in Section 03 11 14.0012 FORMWORK FOR CONCRETE and as shown to have class A finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 16 square inches in area and less than 1/2 inch deep and bug holes exceeding 1/2 inch in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph "Material and Procedure for Repairs." Defective and unsound concrete areas larger than described shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with a latex bonding agent or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph "Material and Procedure for Repairs."

3.4.3.2 Class D Finish

Surfaces listed in Section 03 11 14.00 12 FORMWORK FOR CONCRETE and as shown to have class D finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 48 square inches in area or more than 2 inches deep shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with a latex bonding agent meeting the requirements of paragraph "Latex Bonding Compound," or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph "Material and Procedure for Repairs."

3.4.3.3 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Government Representative. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides.
Including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 40 degrees F during placement, finishing, and curing. Other methods and materials for repair may be used only when approved in writing by the Government Representative. Repairs of the so called "plaster-type" will not be permitted.

3.5 Curing and Protection

3.5.1 Duration

The length of the curing period shall be determined by the type of cementitious material, as specified below. Concrete shall be cured by an approved method.

<table>
<thead>
<tr>
<th>Type</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type III portland cement</td>
<td>3 days</td>
</tr>
<tr>
<td>Portland cement when accelerator is used to achieve high early strength, except when pozzolan is use</td>
<td>3 days</td>
</tr>
<tr>
<td>Type I portland cement</td>
<td>7 days</td>
</tr>
<tr>
<td>Type IS or Type IP cement</td>
<td>7 days</td>
</tr>
<tr>
<td>Type II portland cement (including Type I/II)</td>
<td>14 days</td>
</tr>
<tr>
<td>Portland cement blended with 25 percent or less pozzolan</td>
<td>14 days</td>
</tr>
<tr>
<td>Portland cement blended with more than 25 percent pozzolan</td>
<td>21 days</td>
</tr>
</tbody>
</table>

Immediately after placement, concrete shall be protected from premature drying, extremes in temperature, rapid temperature change, and mechanical damage. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to the start of concrete placement. Concrete shall be protected from the damaging effects of rain for 12 hours and from flowing water for 14 days. No fire or excessive heat including welding shall be permitted near or in direct contact with concrete or concrete embedments at any time.

3.5.2 Moist Curing

Moist-cured concrete shall be maintained continuously, not periodically, wet for the entire curing period. Vertical surfaces shall be cured using soaker hoses, fog sprayers or sprinklers. Burlap may be used to assist moist curing provided that the wall and burlap are kept continuously saturated, including nights and weekends, and the burlap is kept in contact with the concrete being cured. If water or curing materials stain or discolor concrete surfaces that are to be permanently exposed, they shall be cleaned as required in paragraph "Appearance." Where wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. Where steel forms are left in place during curing, the forms shall be carefully broken loose from the hardened concrete and curing water continuously applied into the void so as to continuously saturate the entire concrete surface. Horizontal surfaces may be moist cured by ponding, by covering with a minimum uniform thickness of 2 inches of continuously saturated sand, or by covering with saturated nonstaining burlap or cotton mats. Horizontal construction joints may be allowed to dry for 12 hours immediately prior to the placing of the following lift.
3.5.3 Membrane-Forming Curing Compound

Concrete may be cured with an approved membrane-forming curing compound in lieu of moist curing except that membrane curing will not be permitted on any surface to which other concrete is to be bonded, on any surface containing protruding steel reinforcement or any surface maintained at curing temperature by use of free steam. A pigmented-type curing compound shall not be used on surfaces that will be exposed to view when the project is complete. Concrete cured with nonpigmented curing compound must be shaded from the sun for the first 3 days when the ambient temperature is 90 degrees F or higher.

3.5.3.1 Application

The curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. The surfaces shall be thoroughly moistened with water, and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared and bleeding has stopped. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other cause that will disrupt the continuity of the curing membrane.

3.5.4 Evaporation Retardant

The following concrete surfaces may be cured using sheet material:

Horizontal Surfaces Only

Sheet curing shall not be used on vertical or near-vertical surfaces. All surfaces shall be thoroughly wetted and be completely covered with waterproof paper or polyethylene-coated burlap having the burlap thoroughly water-saturated before placing. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.5.5 Cold-Weather Curing and Protection

When the daily outdoor low temperature is less than 32 degrees F, the temperature of the concrete shall be maintained above 40 degrees F for the first 7 days after placing. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be
controlled so that concrete near the surface will not be subjected to a
temperature differential of more than 25 degrees F as determined by
observation of ambient and concrete temperatures indicated by suitable
temperature measuring devices as required and installed adjacent to the
cement surface and 2 inches inside the surface of the concrete. The
installation of the thermometers shall be made by the Contractor at such
locations as may be directed.

3.6 SETTING OF BASE PLATES AND BEARING PLATES

3.6.1 Setting of Plates

After being plumbed and properly positioned, column base plates, bearing
plates for beams and similar structural members, and machinery and
equipment base plates shall be provided with full bearing with nonshrink
groth. The space between the top of concrete or masonry-bearing surface
and the bottom of the plate shall be approximately 1/24 of the width of
the plate, but not less than 1/2 inch for plates less than 12 inches
wide. Concrete surfaces shall be rough, clean, and free of oil, grease,
and laitance, and they shall be damp. Metal surfaces shall be clean and
free of oil, grease, and rust.

3.6.2 Nonshrink Grout Application

Nonshrink grout shall conform to the requirements of paragraph "Nonshrink
Groth." Water content shall be the minimum that will provide a flowable
mixture and fill the space to be grouted without segregation, bleeding, or
reduction of strength.

3.6.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material
manufacturer's instructions and as specified. Ingredients shall be
thoroughly dry-mixed before adding water. After adding water, the batch
shall be mixed for 3 minutes. Batches shall be of size to allow
continuous placement of freshly mixed grout. Grout not used within 30
minutes after mixing shall be discarded. The space between the top of the
concrete or masonry-bearing surface and the plate shall be filled solid
with the grout. Forms shall be of wood or other equally suitable material
for retaining the grout and shall be removed after the grout has set. If
groth "A" grout as specified in ASTM C1107 is used, all surfaces shall be
formed to provide restraint. The placed grout shall he worked to
eliminate voids; however, overworking and breakdown of the initial set
shall be avoided. Grout shall not be retempered or subjected to vibration
from any source. Where clearances are unusually small, placement shall be
under pressure with a grout pump. Temperature of the grout, and of
surfaces receiving the grout, shall be maintained at 65 to 85 degrees F
until after setting.

3.6.2.2 Treatment of Exposed Surfaces

After the grout has set, those types containing metallic aggregate shall
have the exposed surfaces cut back 1 inch and immediately covered with a
parge coat of mortar proportioned by mass of one part portland cement, two
parts sand, and sufficient water to make the mixture placeable. The parge
coat shall have a smooth, dense finish. The exposed surface of other
types of nonshrink grout shall have a smooth, dense finish.
3.6.3 Curing

Grout and parget coats shall be cured in conformance with paragraph "Curing and Protection."

3.7 TESTS AND INSPECTIONS

Tests and inspections shall conform to the following requirements.

3.7.1 Qualifications

The Contractor shall perform the inspections and tests described below, and, based upon the results of these inspections and tests, he shall take the action required and submit reports as required. When, in the opinion of the Government Representative, the concreting operation is out of control, concrete placement shall cease. The laboratory performing the tests shall conform to ASTM C1077. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete construction shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Construction Special Inspector or Concrete Transportation Construction Inspector. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C1077.

3.7.2 Testing and Inspection for Contractor Quality Control

3.7.2.1 Fine Aggregate

a. Grading - At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C136 and COE CRD-C 104 for the fine aggregate or for each size range of fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

b. Corrective Action for Fine Aggregate Grading - When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Government Representative.

c. Moisture Content Testing - When in the opinion of the Government Representative the electric moisture meter is not operating satisfactorily, there shall be at least four (4) tests for moisture content in accordance with ASTM C566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content.
content shall be used to adjust the added water in the control of the batch plant.

d. Moisture Content Corrective Action - Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device) if necessary to maintain the specified slump.

3.7.2.2 Coarse Aggregate

a. Grading - At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control which are coarser than the specification limits for samples taken at locations other than as delivered to the mixer to allow for degradation during handling.

b. Corrective Action for Grading - When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Government Representative. Where two consecutive averages of five tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Government Representative. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

c. Coarse Aggregate Moisture Content - A test for moisture content of each size group of coarse aggregate in accordance with ASTM C566 shall be made at least twice per week. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified above for fine aggregate, until the difference falls below 1.0 percent.

d. Coarse Aggregate Moisture Corrective Action - Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted if necessary to maintain the specified slump.

3.7.2.3 Deleterious Substances

a. When in the opinion of the Government Representative a problem exists in connection with deleterious substances in fine or coarse aggregates, test shall be made in accordance with ASTM C33 at a frequency not less than one per week.

b. Deleterious Substances Corrective Action - When the results for a deleterious substance are outside the specification limit, the aggregate shall be resampled and retested for the deleterious substance that failed. If the second sample fails, that fact shall be immediately reported to the Government Representative. When material
finer than No. 200 sieve for coarse aggregate exceeds the specification limit, immediate steps, such as washing or other corrective actions, shall be initiated.

3.7.2.4 Scales

a. Weighing Accuracy - The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every 3 months for conformance with the applicable requirements of paragraph "Batch Plant." Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors.

b. Batching and Recording Accuracy - Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. The Contractor shall confirm that the calibration devices described in paragraph "Batch Plant" for checking the accuracy of dispensed admixtures are operating properly.

c. Scales Corrective Action - When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.7.2.5 Batch-Plant Control

The measurement of all constituent materials including each cementitious material, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of each cementitious material used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

3.7.2.6 Concrete Mixture

a. Air Content Testing - Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government quality assurance representative. Tests shall be made in accordance with ASTM C231. Test results shall be plotted on control charts, which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single test result reaches either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the control chart for air content and the control chart for range, and for determining the need for any remedial action. The result of each test, or average as noted
in the previous sentence, shall be plotted on a separate chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph "Air Content." An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line. An upper action limit and a lower action limit line shall be set 2 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Government Representative and the air content at the mixer controlled as directed.

b. Air Content Corrective Action - Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as is practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the control chart range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted. All this shall be at no extra cost to the Government.

c. Slump Testing - In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C143 for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government's quality assurance representative. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made on the same batch of concrete. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control chart for slump and the chart for range, and for determining the need for any remedial action. An upper warning limit shall be set at 1/2 inch below the maximum allowable slump on separate control charts for slump used for each type of mixture as specified in paragraph "Slump," and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer; however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's
materials or transportation methods cause slump loss between mixer and
the placement, correlation samples shall be taken at the placement
site as required by the Government Representative and the slump at the
mixture controlled as directed.

d. Slump Corrective Action - Whenever points on the control chart for
slump reach the upper warning limit, an adjustment shall be
immediately made in the batch weights of water and fine aggregate.
The adjustments are to be made so that the total water content does
not exceed that amount allowed by the maximum W/CM submitted, based
upon aggregates which are in a saturated surface-dry condition. When
a single slump reaches the upper or lower action limit, no further
concrete shall be delivered to the placing site until proper
adjustments have been made. Immediately after each adjustment,
another test shall be made to verify the correctness of the
adjustment. Whenever two consecutive slump tests, made during a
period when there was no adjustment of batch weights, produce a point
on the control chart for range at or above the upper action limit, the
concreting operation shall immediately be halted and the Contractor
shall take appropriate steps to bring the slump under control. Also,
additional slump tests shall be made as directed. All this shall be
at no additional cost to the Government.

e. Temperature - The temperature of the concrete shall be measured
when compressive strength specimens are fabricated. Measurement shall
be in accordance with ASTM C1064. The temperature shall be reported
along with the compressive strength data.

f. Compressive-Strength Specimens - At least one set of test
specimens shall be made each day on each different concrete mixture
placed during the day. Additional sets of test cylinders shall be
made, as directed by the Government Representative, when the mixture
proportions are changed or when low strengths have been detected. A
random sampling plan shall be developed by the Contractor and approved
by the Government Representative prior to the start of construction.
The plan shall assure that sampling is done in a completely random and
unbiased manner. A set of test specimens for concrete with a 28-day
specified strength per paragraph "DESIGN REQUIREMENTS" shall consist
of four cylinders, two to be tested at 7 days and two at 28 days. A
set of test specimens for concrete with a 56-day strength per
specified paragraph "DESIGN REQUIREMENTS" shall consist of six
cylinders, two tested at 7 days, two at 28 days, and two at 56 days.
Test specimens shall be molded and cured in accordance with ASTM C31
and tested in accordance with 7 days. All compressive-strength tests
shall be reported immediately to the Government Representative.
Quality control charts shall be kept for individual strength tests,
moving average for strength, and moving average for range for each
mixture. The charts shall be similar to those found in ACI 214R.

g. Washout Testing - Washout shall be tested in accordance with
COE CRD-C 61 when the first batch arrives each day prior to its
placement.

h. Washout Corrective Action - When a washout test exceeds the
maximum allowed, no concrete shall be delivered to the placing site
until proper adjustments have been made. Immediately after each
adjustment, another test shall be made to verify the correctness of
the adjustment. Also, additional washout tests shall be made as
directed. All this shall be at no additional cost to the Government.
3.7.2.7 Inspection Before Placing

Foundation or construction joints, forms, and embedded items shall be inspected for quality by the Contractor in sufficient time prior to each concrete placement to certify to the Government Representative that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.7.2.8 Placing

a. Placing Inspection - The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, yardage placed, and method of placement.

b. Placing Corrective Action - The placing foreman shall not permit batching and placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.7.2.9 Vibrators

a. Vibrator Testing and Use - The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined at the same time the vibrator is operating in concrete with the tachometer held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

b. Vibrator Corrective Action - Any vibrator not meeting the requirements of paragraph "Vibrators" shall be immediately removed from service and repaired or replaced.

3.7.2.10 Curing

a. Moist-Curing Inspections - At least once each shift, and once per day on non-work days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist-Curing Corrective Action - When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for such areas shall be extended by 1 day.

c. Membrane-Curing Inspection - No curing compound shall be applied

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until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, he shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square feet per gallon. He shall note whether or not coverage is uniform.

d. Membrane-Curing Corrective Action - When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet-Curing Inspection - At least once each shift and once per day on nonwork days, an inspection shall be made of all areas being cured using material sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet-Curing Corrective Action - When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.7.2.11 Cold-Weather Protection and Sealed Insulation Curing

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other deficiencies that could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

3.7.2.12 Cold-Weather Protection Corrective Action

When a daily inspection report lists any holes, tears, unsealed joints, or other deficiencies, the deficiency shall be corrected immediately and the period of protection extended one (1) day.

3.7.2.13 Uniformity of Concrete Mixing

a. Stationary Mixers - Prior to the start of concrete placing and once every six (6) months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C94.

b. Truck Mixers - Prior to the start of concrete placing and at least once every six (6) months, uniformity of concrete shall be determined in accordance with ASTM C94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

3.7.2.14 Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either the mixer shall be removed from service on the work, the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.
3.7.3 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Government Representative has the right to examine all test and inspection records.

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PART 1   GENERAL

1.1   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)


AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A (2011) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

AMERICAN WELDING SOCIETY (AWS)


AWS A3.0M/A3.0 (2010) Standard Welding Terms and Definitions

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel


ASTM INTERNATIONAL (ASTM)

1.3 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0M/A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class) indicate the project's class(es) of weld joints.

1.3.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

1.3.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.3.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.3.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.3.5 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.3.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.4 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the
Government Representative. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.4.2 Mock-up Model

Perform first the field-welded connection designated as the mock-up model on the drawings. All welders, qualified and designated to perform field-welded groove joints, shall be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Simulate with the mock-up test all physical and environmental conditions that will be encountered during the welding of all groove joints. Execute all inspection procedures required for groove welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of groove welded joints shall be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
  Welding Procedure Qualifications; G
  Welder, Welding Operator, and Tacker Qualification; G
  Inspector Qualification
  Previous Qualifications
  Pre-qualified Procedures

SD-06 Test Reports
  Quality Control
  Nondestructive Examination
1.6 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.6.1 General Requirements

To perform this work provide an organization certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category Category I Conventional Steel Structures.

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

(2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

b. For other applications, provide documentation of the following:

(1) Submit for review to the Government Representative six (6) copies of Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) within fifteen (15) calendar days after receipt of Notice to Proceed.

(2) Cranes: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.1/D14.1M.

(3) Submit for review to the Government Representative six (6) copies of Certified Welder Performance Qualifications (WPQ) and Certified Brazer Performance Qualifications (BPQ) within fifteen (15) calendar days prior to any employee welding on the project material.
(4) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.6.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. No pre-qualified welding procedures are allowed. Qualify the welding procedures and welders by tests prescribed in the applicable code or specification not withstanding the fact the code or specification may allow pre-qualified procedures.

1.6.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test results, including those of test welds that failed to meet the requirements, with the welding procedure.

1.6.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.5.1 Previous Personnel Qualifications

At the discretion of the Government Representative, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical
consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.6.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.6.6 Inspector Qualification

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.
1.6.7 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe welding practices and safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Government Representative may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual or magnetic particle inspections to determine conformance with paragraph "STANDARDS OF ACCEPTANCE". Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165, ASTM E709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable. Submit a quality assurance plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds,
and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection ultrasonic, magnetic particle, or dye penetrant methods. The minimum extent of nondestructive testing shall be random 25 percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Government Representative. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph "STANDARDS OF ACCEPTANCE".

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

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PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A (2011) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

ASNT SNT-TC-1A Q&A Bk C (2011; Text Correction 2011) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Ultrasonic Testing Method

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)


1.3  DEFINITIONS

1.3.1  A Scan

Method of data presentation on a cathode ray tube using rectangular coordinates in which a horizontal base line indicates elapsed time when reading from left to right. A vertical deflection in the base line indicates reflect signal amplitude.

1.3.2  Acoustically Similar Material

Material the same as that to be inspected; or another material proven to have acoustical velocity within plus or minus 3 percent and an attenuation within plus or minus 0.25 dB/inch of the inspected material for the inspection frequency and wave mode, using the same mode as that to be used for inspection.
1.3.3 Amplitude

When referring to an indication in A scan presentation, amplitude is the vertical height of the indication measured from peak-to-peak for radio frequency indications and trace-to-peak for video indications.

1.3.4 Attenuation

Dissipation or loss of energy as ultrasonic vibrations travel through the material. Attenuation is caused almost entirely by scattering of the ultrasonic vibrations generated by the search unit.

1.3.5 Attenuation-Correction Controls

Circuitry to provide a continuous increase in amplification with respect to time. This circuitry compensates for the reduction in sensitivity with depth as a result of sound beam divergence and its attenuation in material.

1.3.6 Back Reflection or End Reflection

Reflection from the opposite side, end, or boundary of the material into which the ultrasonic energy was introduced.

1.3.7 Calibrated Gain Control (Attenuator)

Circuitry with which gain can be reduced finite amounts by switching electrical signal attenuation into the circuit.

1.3.8 Calibration

Process of comparing an instrument or device with a standard to determine accuracy or produce a scale.

1.3.9 Cathode Ray Tube (CRT)

An electron tube in which a controlled beam of electrons from the cathode is used to produce an image on a fluorescent screen at the end of the tube.

1.3.10 Couplant

Any material, usually a liquid or semiliquid, used between the search unit and the inspection surface to exclude air and to convey the ultrasonic vibrations between the search unit and the material being inspected.

1.3.11 Damping Control

Control that varies the duration of transducer ringing.

1.3.12 Decibel (dB)

Units for the logarithmic expression of the ratio of power levels. Power levels can be functions of voltage, current, or impedance, for example. Decibel units having no values of their own are only significant when a reference is stated, as 10 dB above one reference level or 6 dB below another reference level.
1.3.13 Delay Control

Means of delaying the pattern obtained on the CRT.

1.3.14 Discontinuity

Anything within a material that will cause a detectable interruption in an ultrasonic beam.

1.3.15 Distance-Amplitude Correction Curve

Curve showing the relationship between signal amplitude and equal-sized reflecting surfaces at various distances from the transducer. Reference standards are used to obtain such curves.

1.3.16 Dynamic Range

Ratio of maximum to minimum size of reflective areas that can be adequately distinguished on the CRT at a constant gain setting.

1.3.17 Effective Depth of Penetration

Maximum depth at which the sensitivity is satisfactory for the quality of test desired.

1.3.18 Examination

Within the context of this specification, examination is equivalent to the word "inspection."

1.3.19 Gain Control

Circuitry designed into the ultrasonic system to vary reflection amplitude. This control is usually calibrated in decibels. It is also called the sensitivity control.

1.3.20 Gross

Background displacement of the trace on the CRT from the established baseline due to the gain setting, the characteristics of the test equipment, or the material under examination.

1.3.21 Hertz

One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of periodic variations starting at one condition and returning once to the same condition is a cycle.

1.3.22 Immersion Techniques

Test methods in which the part to be tested and the search units are immersed in water or other suitable liquid couplant. A mechanical device is used to firmly hold and direct the wave angle of the search unit. The search unit does not contact the item being inspected.

1.3.23 Indication

Visual presentation on the cathode ray screen resulting from a sound beam reflection from a boundary surface or discontinuity.
1.3.24  Initial Pulse Indication

Usually called the "initial pulse". A signal on the CRT screen marking
the instant at which a voltage impulse is applied to the transmitting
crystal. Its rising edge is frequently invisible due to the time lag in
the probe shoe and the consequent necessity to ensure coincidence between
the time base zero and the instant at which the transmitter pulse actually
enters the material under test.

1.3.25  Linearity

Property of an instrument revealed by a linear change in reflected signal
or displacement. The vertical linearity is determined by plotting the
change in ratios of signal amplitude from two adjacent reflections from an
area of known size. The horizontal linearity is determined by plotting
the distance the signal is displaced along the sweep against the change in
material thickness or by noting the spacing of multiple back reflections.

1.3.26  Longitudinal or Compressional Waves

Simple compression-rare-fraction waves in which particle motion within a
material is linear and in the direction of wave propagation. Also called
straight beams, or compressional or normal waves.

1.3.27  Longitudinal Wave Inspection

Ultrasonic technique, normally using straight beam methods, in which
longitudinal waves are the dominant form.

1.3.28  Mid-Screen Reflection

Reflection whose amplitude is equal to one-half the useable screen height
on the CRT.

1.3.29  Megahertz (MHz)

One million hertz per second frequency.

1.3.30  NDT Level I

An NDT Level I individual should be qualified to properly perform specific
calibrations, specific NDT, and specific evaluations for acceptance or
rejection determinations according to written instructions, and to record
results.

1.3.31  NDT Level II

An NDT Level II individual should be qualified to set up and calibrate
equipment and to interpret and evaluate results with respect to applicable
codes, standards, and specifications.

1.3.32  NDT Level III

An NDT Level III individual should be capable of establishing techniques
and procedures; interpreting codes, standards, specifications, and
procedures; and designating the particular NDT methods, techniques, and
procedures to be used.
1.3.33 Node

Distance a shear wave travels in a straight line from the inspection surface before being reflected by the opposite surface.

1.3.34 Pulse Repetition Rate

Number of spaced pulses of sound per second sent into the material being inspected.

1.3.35 Range Control

Means of expanding the pattern obtained on the CRT so that any portion of the total distance being tested can be presented.

1.3.36 Reference Reflector

Standard reflector 0.06 inch diameter reference hole in the IIW reference block. Other approved blocks may have a different diameter reflector.

1.3.37 Reflector

Boundary, consisting of an opposite side, crack, or separation, or a distinct change in material such as slag or porosity that reflects the ultrasonic energy the same as a mirror reflects light.

1.3.38 Refracted Waves

Waves that have undergone change of velocity and direction by passing from one material to another material with different acoustical properties. Refraction will occur wherever the angle of the incident wave to the interface is other than perpendicular.

1.3.39 Rejectable Discontinuity (Defect)

Reflector large enough to produce a signal (decibel rating) that exceeds the reject/repair line.

1.3.40 Resolution

Ability to clearly distinguish signals obtained from two reflective surfaces with a minimum separation distance. Near-surface resolution is the ability to clearly distinguish a signal from a reflector at a minimum distance under the contact or near surface without interference from the initial pulse signal. Far-surface resolution is the ability to clearly distinguish signals from reflectors displaced at minimum distances from the far or back surface when the sound beam is normal to that back surface.

1.3.41 Ringing

Excitation in a transducer due to the application of a short pulse of high voltage.

1.3.42 Scanning

Procedure of moving the search unit or units along a test surface to obtain complete inspection of the entire volume of a material being inspected. Preliminary scanning refers to a somewhat common practice of rapidly traversing a weld ultrasonically with a higher instrument gain or
sensitivity level than will be used for the evaluation. It gives the operator an estimate of the welding quality and also makes all defects more prominent and less likely to be missed.

1.3.43 Search Unit

Device containing a piezoelectric material used for introducing vibrations into a material to be inspected or for receiving the vibrations reflected from the material. The active element of the search unit is defined as the effective transmitting area. Search units are also called transducers or probes. They may be single or dual and contain one or two piezoelectric elements, respectively, for transmission and reception. The single search unit is sometimes enclosed in a transducer wheel or search unit wheel. The search unit may be manually handled and placed in direct contact with the material to be inspected or may be held in a fixture for immersion techniques.

1.3.44 Sensitivity

Measure of the ultrasonic equipment's ability to detect discontinuities. Quantitatively, it is the level of amplification of the receiver circuit in the ultrasonic instrument necessary to produce the required indication on the scope from the reference hole in the reference block. Also see "Standard Reference Level."

1.3.45 Shear Waves

Waves in which the particles within the material vibrate perpendicularly to the direction in which the wave travels or propagates. Also called transverse waves.

1.3.46 Shear Wave Inspection

Inspection technique using shear waves in a material. The search unit is placed at an angle to the contact surface of the material so the resultant refracted sound is a shear wave at an angle to the normal.

1.3.47 Standard Reference Level

Mid-screen height reflection when beaming at the 0.06 inch hole in the primary reference block or the reference hole in the secondary standard.

1.3.48 Surface Waves

Waves that propagate along the surface of the material and penetrate it to only about 1/2-wavelength. Also known as Rayleigh waves.

1.3.49 Test Frequency

Operating frequency in hertz per second of the search unit during period of activation. Frequency is usually expressed in megacycles per second or megahertz. The latter term has been adopted for international use and is preferred.

1.3.50 Video Form

Type of signal presentation on a CRT in which only the upper half of the signal appears.
1.4 SYSTEM DESCRIPTION

Procedures and Methods. Use the pulse echo contact method with an A scan presentation for the ultrasonic inspection of welded joints, except that immersion techniques may be used for some applications when approved by the Government Representative. Use the procedures, methods, standards, and description of equipment specified herein for inspection of weldments. The procedure description shall include the following:

a. Couplant.

b. Search unit characteristics including angle, size, shape, nominal frequency, type designation.

c. Method and type of wave.

d. Equipment and accessories including manufacturer, model number, date of manufacture, last date of calibration, and the manufacturer's electrical, physical, and performance specifications.

e. Decibel (dB) compensation system for distance-amplitude correction.

Perform ultrasonic inspections to detect the following defects:

a. Cracks or crack-like faults.

b. Root defects, including lack of penetration and fusion.

c. Lack of fusion between passes on the sidewall.

d. Porosity or inclusions and excessive undercutting.

1.4.1 Wave Types

The types of waves and the conditions under which they shall be used are specified below:

a. Shear Waves. Unless conditions prohibit, use shear waves. A longitudinal wave procedure may be used instead, if approved by the Government Representative. Use refracted waves between 40 degrees and 70 degrees except where different angles are indicated in approved procedures, such as for materials less than 1/2 inch thick, for materials with sound velocities greater than in steel, when the weldments are not readily accessible, or when existing backing rings or backing strips are not removed. For inspection of weldments containing backing rings or backing strips, adjust the instrument and select the refracted angles in a way to separate the weldment and the backing ring reflections. Establish the search unit angle and the resulting shear wave angle in the material to be inspected for each application and include this information in the procedure submitted for approval.

b. Longitudinal Waves. When conditions prohibit the use of shear waves, longitudinal waves may be used. The procedure shall be specially developed to suit the application and shall have the prior approval of the Government Representative.

1.4.2 Changes in Procedure

Should application of an approved procedure not provide for good resolution or adequate ultrasonic penetration in the items to be inspected (see paragraph "EQUIPMENT QUALIFICATIONS"), make changes in procedure or
equipment such as frequency, pulse repetition rate, angle of search unit, couplant, or oscilloscope. Demonstrate adequacy of the new procedure to the Government Representative. The Government reserves the right to require a change in test equipment during these tests if any of the following test system characteristics fall below the levels listed in paragraph "EQUIPMENT QUALIFICATIONS": sensitivity, amplitude and distance linearity, signal-to-noise ratio, entry and back surface resolution and penetration.

1.4.3 Ultrasonic Equipment

Provide ultrasonic equipment conforming to the requirements listed in AWS D1.1/D1.1M Section Inspection, subsection UT and Part F, with the following exceptions:

a. The ultrasonic test instruments shall be able to generate, receive, and to present pulses in the frequency range from 1 to 10 megahertz (MHz).

b. Measure the horizontal linearity of the ultrasonic instrument in accordance with paragraph "EQUIPMENT QUALIFICATIONS".

c. In addition to the resolution test specified in AWS D1.1/D1.1M, subsection Ultrasonic Equipment, conduct both near- and far-surface resolution tests in accordance with the tests specified for these characteristics in the paragraph "EQUIPMENT QUALIFICATIONS".

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
Ultrasonic Inspection
SD-06 Test Reports
Equipment Qualifications

1.6 QUALITY ASSURANCE

1.6.1 Personnel Qualification

The three levels of responsibility associated with ultrasonic inspection are defined in ASNT SNT-TC-1A. For qualification to perform ultrasonic inspection, personnel shall be certified under ASNT SNT-TC-1A and ASNT SNT-TC-1A Q&A Bk C within a period of 1 year before the date of contract. Other qualification or certification may be accepted at the Government Representative's discretion. Personnel with only an operator or inspector trainee certification will not be considered qualified to pass judgment on the acceptability of inspected items, but may work under the direct supervision of a qualified ultrasonic inspector. Qualified ultrasonic inspectors shall be able to judge the acceptability of the item in accordance with paragraph "ACCEPTANCE/REJECTION LIMITS". Submit a standard reference block and working standards as described in paragraph "
REFERENCE STANDARDS”. The procedures to be used for personnel and equipment qualification, equipment calibration, and inspection, at least 30 days prior to their intended use. Approval by the Government will in no way affect the obligation of the Contractor to employ qualified personnel, equipment, and procedures, and to perform the inspection as specified.

1.6.2 Examinations

If the Government Representative doubts an individual's ability as an operator, inspector, or supervisor, recertify the individual in accordance with ASNT SNT-TC-1A. At the option of the Government, the Government Representative may participate in administering the examination and in evaluating the results.

1.6.3 Reference Standards

Use reference standards to calibrate the inspection equipment, test its operating condition, and record the sensitivity or response of the equipment during the inspection in accordance with paragraph "EQUIPMENT QUALIFICATION". The standards shall comprise a standard reference block and reference specimens as noted below.

a. Provide the standard reference block or primary standard consisting of the IIW block in AWS D1.1/D1.1M, Section Inspection, subsection Reference Standards. Also use the standard reference block in any reinspection on the same basis as the original inspection, even though the reinspection is to be performed by other ultrasonic instruments and accessories.

b. As an option, use other recognized working standards detailed with the IIW block in AWS D1.1/D1.1M such as the Sensitivity Calibration (SC) block. However, such blocks shall be referenced to the IIW block as noted in paragraph "SENSITIVITY CALIBRATION". Include details of their use in the procedure description submitted to the Government Representative. These blocks are the secondary standards. They shall be of acoustically similar material to the welds to be inspected. The secondary standards shall be suited for the applicable tests specified in paragraph "EQUIPMENT QUALIFICATIONS" and shall be used as follows, except where the IIW block is specifically required:

   a. To assure adequate penetration of the base material.
   b. To provide a secondary field standard.
   c. To calibrate the equipment and establish the standard reference level.

1.6.4 Resolution Test Block

Furnish a resolution test block in accordance with the details shown in AWS D1.1/D1.1M Section Inspection, subsection Ultrasonic Equipment.

1.6.5 Equipment Qualifications

Evaluate the ultrasonic instrument and accessories on their arrival at the jobsite, immediately prior to the start of inspection. Evaluate them using the Contractor's furnished primary standard and they shall meet or exceed the requirements listed in paragraphs below. Equipment that does not meet these requirements shall not be used in the inspection. Submit a copy of test results.
a. Requalifications. Requalify the equipment after normal use at intervals not to exceed 40 hours, except as noted, and immediately after maintenance or repair or when the Government Representative considers its operation questionable.

b. Longitudinal Wave System:

1). Vertical Amplitude Linearity. Two adjacent reflections of different amplitudes obtained through the thickness of the primary or secondary standard shall vary in the same proportion as the amplitude of the first reflection is increased in discrete 2-dB increments between 20 percent and 80 percent to full screen height. For each gain setting, the amplitude of each reflection shall vary by the same factor, within plus or minus 5 percent. Requalification is required monthly or as otherwise stated.

2). Horizontal Linearity. The first three multiple reflections obtained through the thickness of the primary or secondary standard shall be equally spaced, within plus or minus 5 percent, when spread over 90 percent of the sweep length. Requalification is required monthly or as otherwise stated.

3). Near-Surface Resolution. Excessive ringing that appears on the CRT to the right of the sound entry point shall not exceed a 1/2 inch equivalent distance in steel with the search unit placed on the 4 inch edge of the IIW (primary) block and positioned for maximum amplitude reflection from the 0.06 inch reference hole of the primary standard. The reference reflector shall be set to mid-screen and the gain shall be increased 20 dB. The reference hole located at least 1/2 inch from one edge of the AWS DSC or SC secondary standard shall be used similarly. Acceptability will be on the same basis as in the primary standard.

4). Far-Surface Resolution. Verify this property of the equipment by the method detailed in AWS D1.1/D1.1M, Section Inspection, subsection Calibration of the Ultrasonic Unit with the IIW or other Approved Calibration Blocks. In addition, the trailing edge of the third reflection shall return to the sweep line and be clearly discernible.

c. Angle Wave System:

1). Vertical (Amplitude) Linearity. Two adjacent multiple reflections from the 0.06 inch reference hole in the primary standard shall vary in the same proportion as the amplitude of the first reflection in discrete 2-dB increments between 20 percent and 80 percent of full screen height. For each gain setting, the amplitude of each adjacent reflection shall vary within plus or minus 5 percent. For testing with the AWS SC or AWS DSC secondary standard, the same criteria shall apply. For the SC block, place the transducer on the longitudinal surface contiguous with the sound entry point lines, whereas the 4 inch longitudinal surface of the DSC block shall be used for the same purpose. Requalification is required monthly, or as otherwise stated.

2). Horizontal Linearity (Angle Wave). The first three multiple echoes, obtained from the 0.06 inch reference hole of the primary standard or from the reference hole in a secondary standard with
the transducer positioned at a minimum of 1 inch sound path distance, shall be equally spaced plus or minus 5 percent when spread over 90 percent of the sweep length. The gain shall be adjusted to give a mid-screen height first reflection. Requalification is required monthly or as otherwise stated.

3). Near-Surface Resolution (Angle Wave). Position the search unit for maximum amplitude using the primary or secondary standard as in the horizontal linearity test. The gain shall be adjusted to give a mid-screen height first reflection and then shall be increased 20 dB. Excessive ringing that appears on the CRT to the right of the sound entry point shall not exceed 1/2 inch equivalent distance in steel.

4). Far-Surface Resolution (Angle Wave). The equipment shall delineate the three resolution holes in the resolution block appropriate for the angle of the transducer to be used in the inspection.

5). Signal-to-Noise Ratio. With the search unit located as in the horizontal linearity test, the gain shall be set to obtain an 80 percent full screen height first reflection. The reference reflection-to-noise-amplitude ratio shall not be less than 10 to 1.

6). Exit Point. Place the search unit on the graduated scale on the 12 inch edge of the primary standard and beam the ultrasound toward the curved edge of the block. The gain shall be set for a mid-screen first reflection. The search unit shall be moved back and forth until the first reflection is maximized. The index line on the side of the search unit shall be within 1/16 inch of the mid-point of the graduated scale in either direction. Requalification is required after 40 hours or as otherwise stated.

7). Transducer Angle. Set the established exit point of the probe over the applicable angle index line scribed on the 8 inch or 12 inch edge, as appropriate, of the primary standard. The gain shall be set to obtain a mid-screen first reflection from the 50 mm plexiglass-lined hole for search units up to 70 percent with the search unit placed on the 8 inch edge. Test search units of large angles that have been approved specifically by the Government Representative from the 12 inch edge using the 0.06 inch reference hole. The search unit shall be moved back and forth to maximize the first reflection. When the material to be inspected is not acoustically similar to the primary standard, the inspection angle shall be within plus or minus 2 degrees of the angle specified in the approved procedure. Requalification is required after 40 hours or as otherwise stated.

d. Submit test reports containing the following information:

a. Identification and Location of Inspected Item: Name and place of the inspected item, the person performing the inspection, and the date of inspection.

b. Detail of Inspections: Details of methods, types of waves used, search units, frequencies, inspection equipment identification, and calibration data with enough information to permit duplication of the inspection at a later date.
c. Response in Calibration: The response from the DSC or SC block used in calibration and for acceptance/rejection in terms of the response from the 0.06 inch reference hole in the standard IIW block (primary standard).

d. Identification of Unacceptable Areas: Locations, dimensions, types, and area of unacceptable defects and discontinuities giving reflections over 50 percent of the reject/repair line. These may be noted on a sketch or marked-up drawing.

e. Record of Repair Areas: A record of repaired areas shall be furnished as well as test results for the repaired areas.

PART 2  PRODUCTS

Not Used

PART 3  EXECUTION

3.1  PREPARATION OF MATERIALS FOR INSPECTION

Surfaces shall be free from the following:

3.1.1  Weld Spatter

Spattering or any roughness that interferes with free movement of the search unit or impairs transmission of the ultrasonic vibrations.

3.1.2  Irregularities

Those which could mask or be confused with defect indications.

3.1.3  Weld Backing Strips

Remove strips that are not to remain in place and eliminate all sharp edges and valleys by grinding or other mechanical means.

3.1.4  Dirt

Remove all loose scale, rust, paint, and dirt from the coupling surface.

3.2  SENSITIVITY CALIBRATION

Perform sensitivity calibration immediately after a change of operators and at least every 30 minutes thereafter as testing proceeds. Recalibration will be required after any power interruption, including a change of source, when the equipment is suspected of being in error, or after relocation of the jobsite. The 30-minute and relocation calibrations may coincide. Allow the instrument to warm up before calibration is attempted. Adjust the instrument range and delay controls to display signals from the reference hole in the primary (IIW block) or secondary standard (DSC or SC block or both) on the viewing screen for the range of distances to be inspected.

3.2.1  Calibration Procedure

Calibrate the test instrument as described below.
3.2.1.1 Longitudinal Wave

In calibrating with the primary standard, position the transducer on the 4 inch edge for maximum reflection from the 0.06 inch reference hole. Adjust the gain so that the first reflection is at 50 percent full scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. If a secondary standard is to be used in the inspection, the reject/repair line shall be established similarly. For the DSC block, the transducer shall be positioned on the 4 inch long surface and with the SC degrees sound entry point lines. Adjustment for loss of signal due to distance shall be compensated for as noted above.

3.2.1.2 Angle Wave

In calibrating with either the primary or secondary standard, position the transducer on the same surfaces as in the case of the longitudinal wave system but over the sound entry point lines appropriate for the angle of the transducer to be used in the inspection. Adjust the gain to give a first reflection that is 50 percent of full-scale response. The top of that indication shall be marked with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. Loss of signal shall be compensated as noted.

3.2.2 Calibration of the Secondary Standards

After adjusting the first reflection from the reference hole in the secondary standard to 50 percent full-scale response for a sheer or longitudinal wave inspection, a maximized reflection from the 0.06 inch reference hole in the primary standard shall be obtained without changing the gain setting. Readjust the gain setting to obtain a 50 percent full-scale reflection and the readjusted setting shall be recorded as required by paragraph "SUBMITTALS", to provide a basis for recalibration when the secondary standard is unavailable.

3.2.3 Equipment With a Calibrated Gain Control (Attenuator)

When a calibrated gain control attenuator is used, position the transducer for a maximum reflection from the reference hole in the secondary standard representing approximately 1/2 the longest inspection distance. This reflection shall be adjusted to mid-scale by varying the gain control accordingly. The difference in decibels between this amplitude and the signal obtained from the first, second, and longest distance reflection obtainable on the secondary standard shall be measured. The differences shall be recorded and plotted on a curve to determine the necessary correction to the amplitude at the various inspection distances. A level of 80 percent of the primary level obtained from the corrected signal heights, is equivalent to the reject/repair line.

3.2.4 Equipment With Electronic Distance Compensation Circuitry

If the difference in amplitude between the first reflection and the reflection obtained from the maximum inspection distance is 1 dB or less, the instrument may be used as is. If not, the procedure used for equipment with a calibrated decibel control shall be used to determine the necessary correction to the reflections obtained at the various inspection...
distances. This characteristic of the equipment shall be re-examined on a monthly basis or as otherwise stated in paragraph "EQUIPMENT QUALIFICATIONS ", and correction factors shall be modified accordingly.

3.2.5 Longitudinal Wave Distance-Amplitude Correction Curve

A distance-amplitude correction curve may be used instead of the calibrated gain control or the electronic circuitry for either the shear or longitudinal wave system as described below:

a. A shear wave distance-amplitude correction curve shall be constructed and drawn on the face of the cathode ray tube (CRT) for inspection of weldments in excess of 1-1/2 inch thick when the design of the test equipment permits. The reference hole in the secondary standard shall be used to construct the distance-amplitude correction curve for a minimum of three node points, 1, 2, and 3. The sensitivity of the instrument shall be adjusted to produce 50 percent full-scale response for the maximized primary reflection and the reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve.

b. A longitudinal wave distance-amplitude correction curve shall be constructed and drawn on the face of the CRT when longitudinal waves are to be used in the inspection for material thicknesses exceeding 1 inch, if design of the test equipment permits. The reference hole in the secondary standard shall be used. Instrument sensitivity shall be adjusted to 50 percent full-scale of the maximized response from the reference hole at 1/2 maximum inspection distance. A reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve. The reflection amplitudes to define this curve shall be taken from the faces of the secondary sensitivity standards which are 1 inch, 2 inch, and 1/2 maximum inspection distance, and the longest distance obtainable from the secondary standard, respectively, from the reference hole. When a correction curve cannot be drawn on the face of the CRT, one of the distance-amplitude correction methods noted above and submitted under the procedure description shall be applied.

3.2.6 Longitudinal Wave Inspections Using Immersion Technique

Use the reference hole in a secondary standard for each different inspection distance. Repair/reject limits shall be established by immersing both the search unit and secondary standard in the liquid bath in which the inspection is to be conducted. Use the procedure noted below:

a. Direct the longitudinal waves from the search unit toward the face of the secondary standard closest to the reference hole.

b. Position the search unit for maximum response. The amplitude of reflection shall be adjusted to 50 percent full-scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair point. The above shall be repeated for each different surface-to-hole distance to establish the reject/repair line.

c. With the gain at the same setting and the primary standard and search unit in air, a maximized reflection shall be obtained from the
0.06 inch reference hole in the primary standard (IIW). Then, this gain setting shall be readjusted to obtain a 50 percent full-scale reflection. The readjusted setting shall be recorded as required by paragraph "SUBMITTALS" to provide a basis for recalibration when the secondary standard is unavailable.

3.3 INSPECTION PROCEDURE

When possible, examine all welds from both sides of the weld and from one surface. If complete inspection cannot be accomplished from one surface, inspection shall be made from another surface that is part of the same joint. Preliminary scanning techniques using an increased instrument gain shall be used to locate possible defects. When possible, gain shall be increased to a minimum of twice (6 dB) the reference level setting. Final acceptance or rejection shall be evaluated with the equipment properly calibrated and the gain control set at the reference level. Use the reject/repair line to evaluate quality of the weld. If a periodic calibration check shows that the equipment is not operating properly or that the system's sensitivity has decreased more than 20 percent (2 dB) from the established sensitivity level, all welds inspected since the prior calibration shall be reexamined. If penetration of the shear waves is questionable, the angle search unit shall be placed in position on one side of the weldment with the waves directed through the weldment. A disconnected angle search unit, plastic or metal wedge or disk, or any good reflector shall be placed in the wave path of the search unit on the far side of the weld to reflect the sound. When good reflections cannot be obtained by either shear or longitudinal waves, modify the procedures.

3.3.1 Test Frequency

The test frequency for ferrous materials shall be as specified in AWS D1.1/D1.1M, Section Inspection, subsection Ultrasonic Equipment, except for thicknesses below 1/2 inch, frequencies between 2.25 and 5 MHz may be used to obtain increased sensitivity. For materials that are difficult to penetrate, any frequency within the operating range of the equipment may be used. The effective depth of penetration and sound beam divergency shall be demonstrated to the Government Representative.

3.3.2 Couplants

The choice of couplant is optional with the Contractor, except as follows:

a. The couplant shall be the same as that used for equipment qualification and calibration.

b. Couplants that may corrode the reference standards and material being tested or leave objectionable residues shall not be used.

c. Oils shall not be used in systems intended to handle liquid oxygen.

d. Couplants shall be of the proper viscosity to give good coupling for the surface roughness.

3.3.3 Shear Wave Inspection

Perform shear wave inspection as follows: Place the search unit on the contact surface at a distance from the weld equal to that used when calibrating the equipment.
3.3.4 Longitudinal Flaws

To detect longitudinal flaws, the search unit shall be slowly moved toward and away from the weld far enough to cover its entire cross section, approximately 90 degrees to the weld centerline. The search unit shall be radially oscillated to the left and right, covering an angle of approximately 30 degrees. During the foregoing movement, the search unit shall be continually advanced parallel to the weld centerline. The rate of movement shall depend on the operator's ability to clearly see and identify all reflections. Calculate the amount of movement to ensure that the inspection distance will be great enough to traverse the weld. For plate thicknesses 2 inches and greater with an unmachined stainless steel overlay covering the welded joint, the inspection distance shall range from a minimum of one thickness (T) or the first node back from the near fusion line to a distance exceeding T plus 2/3, the maximum width of the weld deposit at the surface. Repeat the inspection from the other side of the weld on the same surface if accessible or if not, from another surface that is part of the same joint as indicated above. The surface of the weld metal in the joint shall be ground smooth and blended with the base metal.

3.3.5 Transverse Flaws

To detect transverse flaws when the welded surface is ground flush, the search unit shall be moved along the welded surface in each direction parallel to the centerline of the weld metal with the wave radiating parallel to the weld centerline. To detect transverse flaws when the welded surface is not ground flush, move the search unit parallel to the weld in each direction, on the adjacent base metal at the top of the weld, with the wave directed at an angle of 30 degrees to the weld centerline.

3.3.6 Longitudinal Wave Inspection

This inspection shall be made as follows:

a. The search unit shall be placed on the contact surface with the wave directed in a straight line through any intervening base metal and through the weldment.

b. The search unit shall then be moved slowly in a direction parallel to the weld centerline and zigzagged across an area equivalent to the welded thickness to make sure that waves penetrate the entire welded cross section.

c. The rate of movement shall be dependent on the operator's ability to clearly see and identify all reflections.

3.4 GENERAL ACCEPTANCE/REJECTION REQUIREMENTS

Evaluate discontinuities only when the ultrasonic equipment is calibrated properly. If discontinuities are detected, direct the sound beam to maximize the signal amplitude. To determine the length of a discontinuity, the search unit shall be moved parallel to the discontinuity axis in both directions from the position of maximum signal amplitude. One-half the amplitude or a 6-dB increase in sensitivity from a point at which the discontinuity signal drops rapidly to the baseline shall be defined as the extremity of the discontinuity. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other
The length of the discontinuity shall be defined as the distance between these two marks.

a. For discontinuities with signal amplitudes exceeding full screen height, 50 percent of full screen shall be considered half-peak amplitude. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks.

b. The maximum signal amplitude, length, depth, and position within the inspection zone shall be determined and reported for discontinuities yielding a signal amplitude equal to or exceeding the reject/repair line. The minimum recordable length of a discontinuity shall be 1/8 inch. When evaluating welds joining two members with different thicknesses at the weld, the thickness T shall be the lesser of the two thicknesses.

c. The criteria for acceptance or rejection based on ultrasonic inspection will supplement a visual inspection. The sizes and surface conditions of the welds shall conform to the requirements indicated on the applicable plans and drawings and other sections of the specification. When ultrasonic inspection is used along with radiography, the limits specified under paragraph "REFERENCE STANDARDS" shall supplement the radiographic standards.

3.4.1 Investigation of Questionable Indications

An indication considered doubtful shall be brought to the attention of the Government Representative and, at the Contractor's option, the weld shall be repaired or investigated further. Indications detected within 3/8 inch of accessible surfaces shall be investigated further using liquid penetrant in accordance with ASTM E165 or magnetic particle methods in accordance with ASTM E709, as applicable, to determine if the surface is penetrated. Failure to locate the flaws by one of these methods shall necessitate further investigation by the other. For nonmagnetic materials, only dye penetrant inspection is required. Other questionable defects shall be further investigated using modifications of the inspection procedure.

3.4.2 Inspection of Repairs

All repairs shall undergo the same inspection procedure that originally revealed the discontinuities. Before acceptance, the welds shall meet the standards required for the original weld.

3.5 ACCEPTANCE/REJECTION LIMITS

Accept or reject welds by ultrasonic indication in accordance with the following:

3.5.1 Full Penetration Butt Joints and Corner Joints

3.5.1.1 Class I

Reject welds on the basis of the following:

a. Any evidence of a crack, including any revealed by dye penetrant or magnetic particle in accordance with paragraph "GENERAL ACCEPTANCE/
b. Any indication of a discontinuity such as excessive undercutting, lack of fusion, incomplete penetration, inclusions, or porosity which individually or collectively produce reflections equal to or greater than the established reject/repair line.

c. Any discontinuity with a reflection equal to or exceeding 25 percent of the reject/repair line, up to and including the reject/repair line, shall be rejected where the discontinuity length exceeds 1/2 T or 1 inch.

d. Adjacent discontinuities separated by sound metal with the dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity. The maximum distance between the outer extremities of any two such discontinuities or the sum of their lengths, whichever is greater, shall not exceed the limits specified.

e. If the total cumulative length of the discontinuities in any 12 inches of weld length exceeds T, that weld length shall be rejected.

3.5.1.2 Class II

Reject welds on the basis of the following:

a. Any evidence of a crack, including those revealed by dye penetrant or magnetic particle inspection in accordance with paragraph "GENERAL ACCEPTANCE/REJECTION REQUIREMENTS".

b. Any discontinuity with a reflection exceeding the established reject/repair line and with a length exceeding 1/4 inch. Adjacent discontinuities separated by sound metal with the dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity.

c. Any discontinuity with a reflection greater than or equal to or 50 percent of the reject/repair line, up to and including the reject/repair line, shall be rejected if the discontinuity length exceeds T. In no case shall any single discontinuity length exceed 1-1/2 inches.

d. Adjacent discontinuities separated by sound metal with the dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity. The maximum distance between the outer extremities of any two adjacent discontinuities or the sum of their lengths, whichever is greater, shall not exceed the length as specified above.

e. If the total cumulative length of discontinuities in any 12 inches of weld length exceeds 2 T, that weld length shall be rejected.

3.5.1.3 Class III

Reject welds on the basis of the following:

a. Any discontinuity with a reflection exceeding the established reject/repair line and with a length exceeding 1/2 inch. Adjacent discontinuities separated by sound metal with a dimension less than
twice the length of the longest discontinuity shall be considered a single discontinuity.

b. Any discontinuity with a reflection greater than or equal to 50 percent of the reject/repair line, or with the level 8 dB more than the reject/repair line, and with a length \((L)\) exceeding 2 inches or \(LT\), whichever is greater.

c. If the total cumulative length of discontinuities in any 12 inches of weld length exceeds 3 inches or \(2T\), whichever is greater, that weld length shall be rejected.

3.5.2 Full Penetration Tee Joints

Full Penetration Tee Joints (for Incomplete Root Penetration): Any discontinuity with the reflection exceeding the established reject/repair line of the applicable class shall be rejected. Any discontinuity with a reflection exceeding 25 percent of the established reject/repair line, up to and including the reject/repair line, shall be rejected if its length exceeds \(1/2T\) in a direction transverse to the axis of the weld or \(LT\) parallel to the axis for all classes. If the total cumulative length of discontinuities in any 12 inches of weld length exceeds the limits of the applicable class, that weld length shall be rejected.

3.5.3 Partial and Full Penetration Tee Joints

Partial and Full Penetration Tee Joint Boundaries: The depth of weld penetration and weld cross section width at the through member surface shall be as indicated by applicable plans or drawings. Limits of discontinuities shall be as specified in preceding paragraphs.

3.5.4 Tee Joint Discontinuities

Tee joint discontinuities extending into the through member shall be rejected if reflection exceeds the established reject/repair line.

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PART 1   GENERAL

1.1   SCOPE

Provide the structural steel system, including shop primer or galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 360 and AISC 341 except as modified in this contract.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201 (2006) AISC Certification Program for Structural Steel Fabricators


AISC 326 (2009) Detailing for Steel Construction


AISC DESIGN GUIDE 7 (2004) Industrial Buildings: Roofs to Anchor Rods

AMERICAN WELDING SOCIETY (AWS)


AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel
ASME INTERNATIONAL (ASME)

ASME B46.1 (2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)


ASTM A193 (2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications


ASTM A500 (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes


and Alloy Steel Nuts

ASTM A572  

ASTM A588  

ASTM A6  

ASTM A780  

ASTM A992  
(2011) Standard Specification for Structural Steel Shapes

ASTM C1107  

ASTM C827  
(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

ASTM F1554  
(2007ae1) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

ASTM F436  
(2011) Hardened Steel Washers

ASTM F844  
(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use

ASTM F959  
(2009) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70  
(2010) Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1  
(2000; E 2004) Shop, Field, and Maintenance Painting of Steel

SSPC PS 13.01  
(1982; E 2004) Epoxy Polyamide Painting System

SSPC Paint 25  
(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports; G
Fabrication drawings, including description of connections; G

SD-03 Product Data

Shop primer
Welding electrodes and rods
Non-Shrink Grout
Include test report for Class B primer.

SD-06 Test Reports

Class B coating
Bolts, nuts, and washers
Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel
Bolts, nuts, and washers
Galvanizing
Overhead, top running crane rail beam
Welding procedures and qualifications
1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with OSHA 29 CFR 1926.756(c)(1) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.5.2 Certifications

1.5.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance alignment requirements, areas out of tolerance and proposed corrective measures.

1.5.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing.

1.5.2.3 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A36.
2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel
ASTM A572, Grade 50.

2.1.2.2 Quenched and Tempered Alloy Steel
ASTM A514, Grade B.

2.1.3 Weathering Structural Steel
ASTM A242, Type 1; ASTM A588.

2.1.4 Structural Grade Carbon-Manganese Steel
ASTM A529, high strength carbon-manganese steel of structural quality.

2.1.5 Structural Shapes for Use in Building Framing
Wide flange shapes, ASTM A992.

2.1.6 Structural Steel Tubing
ASTM A500, Grade B.

2.1.7 Steel Pipe
ASTM A53, Type E or S, Grade B, weight class (Standard).

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel

2.2.1.1 Bolts
ASTM A325, Type 1, ASTM A490, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts
ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

2.2.2 High-Strength Structural Steel

2.2.2.1 Bolts
ASTM A325, Type 1 ASTM A490, Type 1.
2.2.2.2 Nuts
ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers
ASTM F436, plain carbon steel.

2.2.3 Weathering Structural Steel
2.2.3.1 Bolts
ASTM A325, Type 3; ASTM A490, Type 3.

2.2.3.2 Nuts
ASTM A563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A325 bolts.

2.2.3.3 Washers
ASTM F436, weathering steel.

2.2.4 Foundation Anchorage
2.2.4.1 Anchor Bolts
ASTM F1554 Gr 36 105, Class 1A. Stainless steel ASTM A193, Grade B7.

2.2.4.2 Anchor Nuts

2.2.4.3 Anchor Washers
ASTM F844. Stainless steel Type 304 conforming to ASTM A276.

2.2.4.4 Anchor Plate Washers
ASTM A36 Stainless steel Type 304 conforming to ASTM A276.

2.2.5 Self-Locking Nuts
Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

2.3 STRUCTURAL STEEL ACCESSORIES
2.3.1 Welding Electrodes and Rods
AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout
ASTM C1107, with no ASTM C827 shrinkage. Grout shall be nonmetallic.
2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A123 or ASTM A153, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 OVERHEAD, TOP RUNNING CRANE RAIL

AISC 325 75 pound crane rail section and welded joints. Provide rail fasteners and a minimum rail length of 10 feet.

2.7 FABRICATION

2.7.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.7.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Government Representative.

2.7.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.7.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating...
manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.7.3 Fireproofing Coated Surfaces

Surfaces to receive sprayed-on fireproofing coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations.

2.7.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.8 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC 201 for Supplement structural steelwork.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement P of AISC 201 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Government Representative.

3.2 INSTALLATION

3.2.1 Overhead, Top Running Cranes

Runway rails and beams shall be provided in accordance with AISC DESIGN GUIDE 7 and CMAA 70, except that in case of conflict, the requirements of CMAA 70 shall govern. Crane rail splices shall be bolted or welded. In addition, provide a maximum vertical difference of 0.03 inch in the elevation between adjacent runway rail tops and adjacent runway beam tops at joints, a maximum horizontal rail separation at joints not to exceed 0.0625 inch. Vertical and horizontal alignment at joints should be maintained as closely as possible. Rail joints shall be ground flush as necessary to provide a smooth transition from each rail segment to the next. Provide adjustable runway support connections to allow placement of the crane rails and beams to the tolerances specified. Rail joints on
opposite sides of the runway shall be staggered. Stagger rail joints a minimum of one foot, except that the stagger shall not be the same as the crane wheel spacing.

3.3 ERECTION

a. Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of endorsement F of AISC 201. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance with AISC DESIGN GUIDE 10.

c. Do not splice truss top and bottom chords except as approved by the Government Representative. Chord splices shall occur at panel joints at approximately the third point of the span. The center of gravity lines of truss members shall intersect at panel points unless otherwise approved by the Government Representative. When the center of gravity lines do not intersect at a panel point, provisions shall be made for the stresses due to eccentricity. Cumber of trusses shall be 1/8 inch in 10 feet unless otherwise indicated.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.4.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Government Representative for further instructions.

3.4.2 High-Strength Bolts

ASTM A325 and ASTM A490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned,
progressing from the most rigid part of a connection to the free edges.

3.4.2.1 Installation of Load Indicator Washers (LIW)

ASTM F959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F436 washers under both the bolt head and nut when ASTM A490 bolts are used.

3.5 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Government Representative.

3.6 WELDING

AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.6.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Removal is not required.

3.7 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.7.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.8 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.9 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals
required for testing. The Government Representative shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.9.1 Welds

3.9.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.9.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the Government Representative. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Government Representative. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

3.9.2 Load Indicator Washers

3.9.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F959.

3.9.3 Overhead, Top Running Crane Rails and Beams

Runway rails and beams shall be surveyed (horizontally and vertically) after installation to verify compliance with the tolerance requirements of AISC DESIGN GUIDE 7, CMAA 70, and the additional alignment tolerance requirements specified in this section. After each survey, submit a written report to the Government Representative with the following information: field alignment survey results, tolerance requirements, areas out of tolerance, and proposed corrective measures. Proposed corrective measures shall be approved by the Government Representative. Following completion of corrective measures, areas that were previously out of tolerance shall be re-surveyed and another written report shall be furnished to the Government Representative. Field surveys shall be performed and sealed by a registered land surveyor.

3.9.4 High-Strength Bolts

3.9.4.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the
manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.9.4.2 Inspection

Inspection procedures shall be in accordance with AISC 360. Confirm and report to the Government Representative that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.9.4.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The Contractor shall allow access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Government Representative. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.
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STEEL JOIST GIRDER FRAMING

07/07

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor and materials and performing all operations in connection with the installation of steel joist girder framing in accordance with these specifications and applicable plans.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)


AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

STEEL JOIST INSTITUTE (SJI)

SJI LOAD TABLES (2005; Errata 1 2006; Errata 2 2007; Errata 3 2007) 42nd Edition Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15 (1999; E 2004) Steel Joist Shop Primer

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1200 Hazard Communication

29 CFR 1926 Safety and Health Regulations for
Construction

29 CFR 1926.757 Steel Erection; Open Web Steel Joists

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
   Welder qualification
   Material Safety Data Sheet (MSDS) per OSHA 29 CFR 1910.1200

SD-02 Shop Drawings
   Steel joist girder framing; G

SD-06 Test Reports
   Erection inspection
   Welding inspections

SD-07 Certificates
   Accessories
   Certification of Compliance

1.5 REGULATORY REQUIREMENT

All joist girder framing must conform to 29 CFR 1926.757. Secure all joist bridging and anchoring in place prior to the application of any construction loads. Distribute temporary loads so that joist capacity is not exceeded. Do not apply loads to bridging.

1.6 DELIVERY AND STORAGE

Handle, transport, and store joist girders in a manner to prevent damage affecting their structural integrity. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling.

1.7 QUALITY ASSURANCE

All work must comply with the requirements set forth in 29 CFR 1926.

1.7.1 Drawing Requirements

Submit steel joist girder framing drawings. Show joist girder type and size, layout in plan, and erection details including methods of anchoring, framing at columns and/or bearing points, type and spacing of bridging, requirements for field welding, and details of accessories as applicable.
1.7.2 Certification of Compliance

Prior to construction commencement, submit Material Safety Data Sheet per 29 CFR 1910.1200 for steel joist girders, and certification for welder qualification, compliance with AWS B2.1/B2.1M, welding operation, and tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

Submit certification of compliance for the following:

- SJI TD 9
- SJI TD 11
- 29 CFR 1926
- 29 CFR 1926.757

PART 2 PRODUCTS

2.1 JOIST GIRDERS AND ACCESSORIES

Provide design data from SJI LOAD TABLES for the joist girders series indicated.

2.2 PAINTING

2.2.1 Shop Painting

Clean and prime joists in accordance with SSPC Paint 15 as specified in Section 09 90 00 PAINTS AND COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Handling and Erection

Conform to SJI LOAD TABLES for the joist girder series indicated.

3.1.2 Welding

All welding must conform to AWS B2.1/B2.1M and AWS D1.1/D1.1M and in accordance with Section 05 05 23 WELDING, STRUCTURAL.

3.2 BEARING PLATES

Provide bearing plates to accept full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate must be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout must be as specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joist girders and joists, touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.
3.3.2 Field Painting

Paint joists girders and joists requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTING AND COATING.

3.4 VISUAL INSPECTIONS

3.4.1 Erection Inspection

AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors. Welding inspectors must visually inspect and mark welds.

-- End of Section --
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DIVISION 05 - METALS

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METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

This section specifies general workmanship requirements, applicable to the fabrication, assembly and testing of various items of metalwork and machine work to insure conformance with the specifications. These requirements are in addition to those contained in the specification sections covering the specific items of work or indicated on the drawings.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASME INTERNATIONAL (ASME)

ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

RCSC A.1 Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Shop drawings shall be submitted for approval in accordance with the Contract Clauses. Drawings shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of materials as appropriate.

Schedule of Welding Procedures; G

A complete schedule of welding procedures as described in paragraph "Welding Procedures" shall be submitted to the Government Representative and approved before fabrication commences.

SD-03 Product Data

Materials

The Contractor shall furnish the Government Representative three (3) copies of all purchase and mill orders, shop orders for materials and work orders, including all new orders placed by Contractors and old orders extended by each supplier. The Contractor, at the time of submittal of shop drawings, shall furnish a list designating the material to be used for each item. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. The Contractor shall also furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site, giving the designation mark and weight of each piece, the number of pieces, the total weight, and if shipped by rail in carload lots, the car initial and number.

SD-07 Certificates

Certificates; G

Certificates for material tests, examinations, and welding procedure and operator qualifications shall be submitted for approval as specified.

1.5 QUALITY CONTROL

1.5.1 Tests of Materials

The Contractor shall, at his expense, perform analyses and tests to demonstrate that all materials are in conformity with the specifications. Should the Contractor desire to use stock materials not manufactured specifically for the work covered by these specifications, he shall submit evidence, satisfactory to the Government Representative, that such
material conforms to the requirements of the specifications. Detailed
tests of these materials will then not be required, if so approved by the
Government Representative. Tests, except where modified, shall be made as
indicated in the respective detailed specifications or on the drawings
and, unless otherwise authorized, in the presence of the Government
Representative. The Contractor shall furnish specimens and samples for
additional independent tests and analyses upon request by the Government
Representative. Specimens and samples shall be properly labeled and
prepared for shipment.

1.5.2 Special Test Requirements

1.5.2.1 Nondestructive Testing

When doubt exists as to the soundness of any material part, such part may
be subjected to any form of nondestructive testing determined by the
Government Representative. This may include ultrasonic, magnaflux, dye
penetrant, x-ray, gamma ray or any other test that will thoroughly
investigate the part in question. The cost of such investigation will be
borne by the Government. Any defects will be cause for rejection and
rejected parts shall be replaced and retested at the Contractor's expense.

1.5.3 Workmanship

Workmanship shall be of the highest grade and in accordance with the best
modern practices to conform with the specifications for the item of work
being furnished.

1.5.4 Quality Control

The Contractor shall establish and maintain a quality control system to
assure compliance with the contract requirements and shall maintain
records of all quality control operations covered by these specifications.

1.5.5 Reporting

The original and two (2) copies of the records specified in paragraph
"Tests of Materials", "Special Test Requirements" and "Workmanship", as
well as the records of corrective action taken, shall be furnished the
Government daily. Format of the report shall be as prescribed in Section
01 45 04.00 10 "CONTRACTOR QUALITY CONTROL".

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

All nuts shall be equipped with washers. Beveled washers shall be used
where bearing faces have a slope of more than 1:20 with respect to a plane
normal to the bolt axis.

2.1.2 Bolts, Nuts, and Washers

The finished shank of each bolt shall be long enough to provide full
bearing and washers shall be used to provide full grip when the nut is
tightened.
PART 3 EXECUTION

3.1 STRUCTURAL FABRICATION

3.1.1 Material

New material, including replacement members for existing components damaged during the modification process, must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except, where welding is definitely specified, indicated on the drawings, or otherwise approved. Bends, except for minor details, shall be made by approved dies, press brakes or bending rolls. Where heating is required precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner as not to destroy the original properties of the metal. Flame cutting of material other than structural steel shall be subject to approval and, where proposed, shall be indicated on shop drawings submitted to the Government Representative. Shearing shall be accurately done and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown on the drawings. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Finished members shall be free from twists, bends and open joints. Bolts, nuts and screws shall be tight.

3.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand guided torches provided an accurate profile with a smooth surface which is free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1/D1.1M, Subsection 3.2. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand guided cuts not exposed to view. Hand guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

3.2 WELDING

3.2.1 Structural Steel

3.2.1.1 General

Unless otherwise authorized or specified, welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal. Welding, unless otherwise specified or authorized shall conform to the applicable provisions of AWS D1.1/D1.1M.

3.2.1.2 Welding Equipment

All items of welding equipment shall conform to the requirements of AWS D1.1/D1.1M.

3.2.1.3 Welding Procedures

The Contractor shall prepare for submission to the Government Representative a complete schedule of welding procedures which shall consist of detailed procedure specifications for each structure to be welded and tables or diagrams showing the procedure to be used for each
required joint. The schedule shall conform to the provisions of AWS D1.1/D1.1M, including filler metal requirements, preheat and interpass temperature requirements and any stress relief heat treatment, and show types and locations of welds designated on the drawings and/or in the specifications to receive nondestructive examination. The procedures shall be such as to minimize residual stresses and distortion of the completed weldment. Procedures shall be qualified by tests as prescribed in AWS D1.1/D1.1M, Section 4, Part B except for prequalified procedures described in AWS D1.1/D1.1M, Section 3. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish the joint welding procedure as prequalified. Each procedure shall be clearly identified as being either prequalified or qualified by tests. The test welding and specimen testing must be witnessed and the test report document signed by a representative of the Government Representative. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Government Representative. Approval of any procedure, however, will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications.

3.2.1.4 Qualifications of Welders and Welding Operators

Welding operators, welders, and tack welders shall be qualified and requalified if necessary for the particular type of work to be done. Qualification shall be in accordance with AWS D1.1/D1.1M, or ASME BPVC SEC IX.

The Contractor shall certify by name to the Government Representative the welders and welding operators so qualified, including the date of qualification, certificates, and code and procedures under which qualified. Prior qualification may be accepted if welders have performed satisfactory work under the code for which qualified within the preceding three months. The Contractor shall require the welder and welding operators to repeat the qualifying tests when, in the opinion of the Government Representative, his work indicates a reasonable doubt as to proficiency. In such cases, he shall be recertified, as above, if he successfully passes the retest; otherwise, he shall be disqualified until he has successfully passed a retest. All expenses in connection with qualification and requalification shall be borne by the Contractor.

3.2.1.5 Technique

a. Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures to be furnished by the Contractor. To maintain low moisture of low hydrogen electrodes, a controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.1/D1.1M, Subsection 5.3.2.

b. Preheat and Interpass Temperature - Preheating shall be performed as required by AWS D1.1/D1.1M, Subsection 3.5 or as otherwise specified except that the temperature of the base metal shall be at least 70 degrees F. The weldments to be preheated shall be slowly and uniformly heated by approved means to the
prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

c. **Stress-Relief Heat Treatment** - Where stress relief heat treatment is specified or shown on the drawings, it shall be in accordance with the requirements of AWS D1.1/D1.1M, Subsection 5.8, unless otherwise authorized or directed by the Government Representative.

### 3.2.1.6 Workmanship

a. **Preparation of Base Metal** - Prior to welding, the Contractor shall inspect surfaces to be welded to assure compliance with AWS D1.1/D1.1M, Subsection 5.15.

b. **Temporary Welds** - Temporary welds required for fabrication and erection shall be made under the controlled conditions prescribed herein for permanent work. All temporary welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified elsewhere in these specifications. Preheat furnished for temporary welds shall be as required by AWS D1.1/D1.1M for permanent welds except that the minimum temperature shall be 120 degrees F in any case. In making temporary welds, arcs shall not be struck in other than weld locations. Each temporary weld shall be removed after serving its purpose and ground flush with adjacent surfaces.

c. **Tack Welds** - Tacks welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds. Preheating shall be performed as specified above for temporary welds. Such tack welds shall be cleaned and fused thoroughly with the permanent welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding.

### 3.2.1.7 Inspection

Welding shall be subject to inspection by the Government Representative to determine conformance with the requirements of AWS D1.1/D1.1M, and the approved welding procedures and provisions stated elsewhere in these specifications. The Government Representative will require nondestructive examination of designated welds and may require supplemental examination of any joint or coupon cut from any location in any joint. The Contractor shall maintain an approved inspection system and perform required inspections in accordance with the Section 00700 Standard General Conditions, Article 6:

a. **Visual Examination** - Prior to any welding, the Contractor shall visually inspect the preparation of material for welding to assure compliance with AWS D1.1/D1.1M. All completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement, and other surface defects to insure compliance with the requirements of AWS D1.1/D1.1M. Defects shall be corrected as provided in paragraph "Inspection" (d).

b. **Test Coupons** - The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive examination.
Should any two coupons cut from the work of any welder show strengths under test less than that specified for the base metal, it will be considered evidence of negligence or incompetence and such welder shall be removed from the work. When coupons are removed from any part of a structure, the members cut shall be repaired in a neat workman like manner with joints of the proper type to develop the full strength of the members, with peening as approved or directed to relieve residual stress. The expense for removal and testing of the coupons, repair of cut members and the performance of nondestructive examination of repairs shall be assigned to the Government or the Contractor in accordance with Section 00700, Article 13.

c. Supplemental Examination - The Government reserves the right to perform supplemental nondestructive examinations as deemed necessary when the soundness of any weld is in doubt and to detect cracking or similar defects that might occur during shipment or erection and before final acceptance by the Government. The cost of such inspection will be borne by the Government. The repairs and the reexamination of repairs will be performed by the Contractor at no additional cost to the Government.

d. Repairs for Structural Steel - Defective weld metal shall be removed by air carbon-arc or oxygen gouging to sound metal. The surfaces shall be thoroughly cleaned before welding. The resulting cavities shall be rewelded in compliance with Article 5.26 of AWS D1.1/D1.1M. When deemed necessary by the Government Representative, the Contractor shall submit a welding repair plan for approval before repairs are made. Welds that have been repaired shall be retested by the same methods used in the original inspection. All costs of repairs and testing shall be borne by the Contractor, except for repair of members cut to remove test coupons which were found to contain acceptable welds.

e. Oxygen Cutting - In all oxygen cutting, flame shall be so adjusted and manipulated as to avoid cutting beyond the prescribed lines. Cut surfaces and edges shall be left free of slag.

3.3 BOLTED CONNECTIONS

3.3.1 Structural Steel Connections

Bolts, nuts and washers shall be of the type specified or indicated on the drawings. All nuts shall be equipped with washers except for high strength bolts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated on the drawings, the materials, workmanship and installation shall conform to the applicable provisions of RCSCA.1.

3.3.1.1 Bolt Holes

Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

a. Regular Bolt Holes - Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.
b. **High Strength Bolt Holes** - Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than the bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolt, the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting done during assembly shall not distort the metal or enlarge the holes. For slight mismatching, reaming to a larger diameter of the next standard size bolt will be allowed.

c. **Existing Bolt Holes** - Existing bolt holes being reused shall be cleaned of all burrs, grease, oil or other debris prior to re-installation of Pump Station Structure to its final position.

d. **New Holes in Existing Members** - New holes in existing steel members shall be field drilled. Burning of holes will not be permitted. Hole size shall not exceed the diameter of the fastener plus 1/16".

3.4 MISCELLANEOUS PROVISIONS

3.4.1 Metallic Coatings

3.7.1.1 Zinc Coatings

Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A123 or ASTM A153 as applicable. In all cases where zinc coatings are destroyed by cutting, welding or other causes, the affected areas shall be regalvanized per the requirements of ASTM A780.

3.5 REMOVAL AND RE-INSTALLATION

3.5.1 General

All parts to be removed, modified and re-installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Pipe wrenches, cold chisels, or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for removal, modifying, re-assembling and tightening parts. Bolts shall be tightened firmly and uniformly, but care shall be taken not to over stress the threads. When a half nut is used for the purpose of locking a full nut, the half nut shall be placed first and followed by the full nut. Threads of all bolts, except high strength bolts, and nuts shall be lubricated by graphite and oil before assembly. Driving and drifting bolts or keys will not be permitted.

3.5.2 Alignment and Setting

Each structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no distortion of any member occurs before it is fastened in place.

-- End of Section --
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PART 1 GENERAL

1.1 SCOPE

The work covered by this Section consists of furnishing all plant, labor, materials and equipment, and furnishing and installing the miscellaneous metalwork as shown on the drawings and specified herein and shall include, but is not limited to the following items:

1.1.1 Corrosion Resistant Steel (C.R.S.)

(1) Settlement reference bolts.

(2) Identification tag for reference bolts.

(3) Bolts, hex cap screws, anchor bolts, threaded studs, washers, nuts, set screws, and seal retaining bars.

1.1.2 Fabricated Steel

(1) Slip joint, Structure to T-Wall on headworks.

1.1.3 Manufactured Products

(1) Galvanized #18 US gage steel sheet metal

(2) Eyehooks, turnbuckles, clevises, plastic sealant, grout, and anchors as specified herein.

(3) Embedments

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 RELATED WORK SPECIFIED ELSEWHERE

(1) SUBMITTAL PROCEDURES, Section 01 33 00

(2) CONTRACTOR QUALITY CONTROL, Section 01 45 04.00 10

(3) CAST-IN-PLACE STRUCTURAL CONCRETE, Section 03 31 00.00 12

(4) REINFORCING STEEL, Section 03 21 00.00 12

(5) METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS, Section 05 50 03.00 12

(6) PAINTING: COAL TAR EPOXY SYSTEM, Section 09 97 02.01 12
1.4 REFERENCES

The publications listed below form a part of this specification to the extent specified herein. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM A500 (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A615 (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement


ASTM A996 (2009b) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement


ASTM D1187 (1997; R 2011e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (2004; E 2004) Power Tool Cleaning

SSPC SP 6 (2007) Commercial Blast Cleaning
1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabricated and Manufactured Items; G

The Contractor shall prepare and submit for approval, complete shop drawings and descriptive literature showing details of all auxiliary items required as indicated herein or on the contract drawings. Shop drawings shall indicate computed weights of structural steel and approval of shop drawings will constitute acceptance of the computed weights shown on these drawings.

SD-03 Product Data

Signage; G

Contractor shall submit manufacturer's data on signage including dimensions, materials and mounting recommendations.

SD-07 Certificates

Manufacturer's Certification; G

The galvanizing compound shall be certified for compliance with all specification requirements.

1.6 QUALITY CONTROL

1.6.1 General

The Contractor shall establish and maintain quality control for proper fabrication and installation of all work covered in this Section to assure compliance with Contract Specifications and maintain records of his quality control for all construction operations including but not limited to the following:

(1) Fabrication.

(2) Protective coating.

(3) Placement and protection.
(4) Material compliance with plans and specifications.

1.6.2 Reporting

The original and two (2) copies of these records and tests, as well as the records of corrective action taken, shall be furnished to the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL.

1.7 QUALIFICATION OF WELDERS AND WELDING WORK

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.8 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 FABRICATED AND MANUFACTURED ITEMS

Fabrication and placement of all fabricated items shall be as indicated on the drawings and shall conform to the applicable provisions of Section 05 50 03.00 12, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.1.1 Corrosion Resistant Steel

Corrosion resistant steel shall conform to ASTM A276, Type 304. High strength corrosion resistant steel shall conform to ASTM A276, Type 431. Corrosion resistant steel bolts, nuts and washers shall conform to the applicable provisions of paragraph "Bolts, Nuts, Washers, Pins and Screws".

2.1.2 Bolts, Nuts, Washers, Pins and Screws

Bolts, nuts, washers, pins, screws and other fasteners shall be the sizes and materials as shown on the drawings and as specified in Section 05 50 03.00 12, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.1.3 Expansion Anchors

Expansion anchors shall meet the requirements of CID A-A-1923, Type 4. Anchors shall be galvanized unless otherwise indicated.

2.1.4 Epoxy Anchors

Epoxy anchors shall be HVA Adhesive System as manufactured by Hilti Corporation or approved equal. System shall consist of HVU adhesive capsules and stainless steel HAS rods with stainless steel washers and nylon-insert locknuts as specified in Section 05 50 03.00 12, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.1.5 Plastic Sealant

Sealant shall conform to the provisions of FS SS-S-210.
2.1.6 Ductile Embedments

Ductile embedments shall be F-54 SAE ductile embed as manufactured by Dayton/Richmond or approved equal. Alternative shall meet the pullout and shear values of the Dayton/Richmond embeds. Sizes and styles shall be as shown on the drawings.

2.2 MATERIALS

2.2.1 Structural Carbon Steel

ASTM A36.

2.2.2 Structural Tubing

ASTM A500.

2.2.3 Dowels

ASTM A615, ASTM A996, ASTM A36.

2.3 FABRICATION FINISHES

2.3.1 Galvanizing

Hot-dip galvanizing or zinc coating applied on products fabricated from rolled, pressed, or forged steel shapes, plates, bars, and strips shall comply with ASTM A123. Hot-dip galvanizing or zinc coatings on assembled steel products shall comply with ASTM A123. Weight of coatings shall be as designated in Table 1 of the ASTM specification for class and thickness of material to be coated, but in no case shall it be less than 1.25 ounces per square foot.

2.3.2 Stainless Steel

Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Government Representative. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3.4 Shop Cleaning and Painting

2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until
thoroughly clean.

2.3.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.3.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.4 MANUFACTURER'S CERTIFICATION

The rubber seals shall be certified for compliance with all specification requirements.

2.5 SIGNAGE

Signs shall be sized as required per plans 0.080 inch thick aluminum, reflective finish with white background and blue letters as manufactured by Traffic Control Products Co. of Louisiana, Inc or approved equal. Aluminum sheets or plates shall conform to ASTM B209, Alloy 6061-T6 or Alloy 5052-H38. Signs shall read, as shown on the plans.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

All metalwork fabrication and machine work shall comply with the applicable provisions of Section 05 50 03.00 12, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. All parts shall be properly fabricated, assembled and installed to conform to the shapes, sizes and dimensions indicated on the Contract Drawings and approved shop drawings.

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and
3.3 SETTLEMENT REFERENCE BOLTS

Upon installation of the settlement reference bolts the Contractor shall determine elevations of each bolt and submit his results to the Government Representative.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with Section 05 05 23 WELDING, STRUCTURAL. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, or absorptive materials subject to wetting, protect with ASTM D1187, asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Government Representative.

3.6 SHOP PAINTING

Corrosion-resistant and galvanized steel items shall not be painted. Corrosion-resistant steel shall be cleaned as specified in Section 05 50 03.00 12, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. Anchors to be embedded in concrete shall not be painted. All other ferrous metal shall be cleaned and shop painted before delivery to the project site. Requirements governing cleaning and painting are as specified in Section 09 97 02.01 12, PAINTING: COAL TAR EPOXY SYSTEM.

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SECTION 05 51 33

METAL LADDERS

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PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)


ASTM A500 (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes


ASTM A653 (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ASTM A924 (2010a) Standard Specification for General
Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process


ASTM D1187 (1997; R 2011e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (2004; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27 Fixed Ladders

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Ladders, installation drawings; G

SD-03 Product Data
   Ladders; G

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with Section 05 05 23 WELDING, STRUCTURAL. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove
and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel
   ASTM A36.

2.1.2 Structural Tubing
   ASTM A500.

2.1.3 Steel Pipe
   ASTM A53, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe
   Standard malleable iron fittings ASTM A47.

2.1.5 Aluminum Alloy Products
   Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26 or ASTM B108 for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing
   Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123, ASTM A153, ASTM A653 or ASTM A924, G90, as applicable.

2.2.2 Galvanize
   Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces
   Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Government Representative. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation
   Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with
SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with standard mill finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF45.

2.3 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 16 inches wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.
3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion anchors, and powder-actuated fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine bolts, carriage bolts and powder-actuated threaded studs for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with Section 05 05 23 WELDING, STRUCTURAL. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187, asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Government Representative.
3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 1/2 inch diameter expansion bolts. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. Ends of ladders must not rest upon finished roof or floor.

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PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)


AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M  (2012; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1  (2010) Square and Hex Bolts and Screws (Inch Series)


ASTM INTERNATIONAL (ASTM)


ASTM A283  

ASTM A307  
(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A325  

ASTM A36  

ASTM A449  

ASTM A467  

ASTM A500  
(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A53  

ASTM B221  

ASTM B26  

ASTM B429  

ASTM C514  

ASTM C636  

ASTM E488  

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521  

SECTION 05 52 00 Page 3
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Fabrication Drawings; G
   Steel Hardware
   Steel Shapes, Plates, Bars and Strips

SD-03 Product Data
   Structural Steel Plates, Shapes, and Bars
   Concrete Inserts
   Masonry Anchorage Devices
   Protective Coating
   Steel Railings and Handrails; G
   Anchorage and Fastening Systems; G

SD-07 Certificates
   Welding Procedures
   Welder Qualification

SD-08 Manufacturer's Instructions
   Installation Instructions

ADMINISTRATIVE REQUIREMENTS

1.4 Pre-Installation Meetings

Within 60 days of Contract Award, submit fabrication drawings to the Government Representative for the following items:

a. Shapes, Plates, Bars and Strips
b. Railings and Handrails
c. Anchorage and fastening systems

Submit manufacturer's catalog data, including two (2) copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

a. Structural steel plates, shapes, and bars
b. Concrete inserts

c. Masonry anchorage devices

d. Protective coating

e. Steel railings and handrails

f. Anchorage and fastening systems

1.5 QUALITY ASSURANCE

1.5.1 Welding Procedures

Section 05 05 23 WELDING, STRUCTURAL applies to work specified in this section.

Submit welding procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Government Representative and by an approved testing laboratory at the Contractor's expense.

1.5.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition be performed on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, make an immediate retest of two test welds and ensure each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication and installation drawings for all steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 GENERAL FABRICATION

Provide railings and handrails detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.
Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.3 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to ASTM A283, Grade C.

Provide steel bars and bar-size shapes conforming to ASTM A36, unless otherwise noted.

2.4 STEEL PIPE

Provide pipe conforming to ASTM A53, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.5 CONCRETE INSERTS

Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts; cast steel conforming to ASTM A27, hot-dip galvanized in accordance with ASTM A153.

Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with ASTM A153. Provide slotted-type concrete inserts consisting of galvanized 1/8-inch thick pressed steel plate conforming to ASTM A283, made of box-type welded construction with slot designed to receive 3/4-inch diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with...
2.6 MASONRY ANCHORAGE DEVICES

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488 and ASTM C514 as follows:

Provide lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded nut type, single unit class, Group I, Type 1, Class 1.

Provide lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 2.

Provide bolt anchor expansion shields for lag bolts; zinc-alloy, long shield anchors class, Group II, Type 1, Class 1.

Provide bolt anchor expansion shields for bolts; closed-end bottom bearing class, Group II, Type 2, Class 1.

Provide tumble-wing type toggle bolts conforming to ASTM A325, ASTM A449 and ASTM C636, type, class, and style as required.

2.7 FASTENERS

Provide galvanized zinc-coated fasteners in accordance with ASTM A153 used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ASTM A307, Grade A.

Provide square-head lag bolts conforming to ASME B18.2.1.

Provide cadmium-plated steel machine screws conforming to ASME B18.6.3.

Provide flat-head carbon steel wood screws conforming to ASME B18.6.1.

Provide plain round, general-assembly-grade, carbon steel washers conforming to ASME B18.21.1.

Provide helical spring, carbon steel lockwashers conforming to ASME B18.2.1.

2.8 PROTECTIVE COATING

Provide hot dipped galvanized steelwork as indicated in accordance with ASTM A123. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.9 STEEL RAILINGS AND HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 20 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.
2.9.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53 or structural tubing conforming to ASTM A500, Grade A or B of equivalent strength. Provide steel railings of 1 1/2 inches nominal size, hot-dip galvanized and shop painted.

a. Fabrication: Joint posts, rail, and corners by one of the following methods:

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

(2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Provide removable sections as indicated.

Provide kickplates between railing posts where indicated, and consist of 1/8-inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

Provide galvanized railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components.

2.10 ALUMINUM RAILINGS AND HANDRAILS

Provide railings and handrails consisting of 1 1/2 inch nominal schedule 40 pipe ASTM B429, 1 3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B221. Provide mill finish aluminum railings. Ensure all fasteners are Series 300 stainless steel.

a. Fabrication: Provide jointing by one of the following methods:

(1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8 inch recessed head set screws.

(2) Ensure all mitered and welded joints made by fitting post to top rail, intermediate rail to post, and corners, are groove welded and ground smooth. Provide butted splices, where allowed by the Government Representative, reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Tack weld or epoxy cement dowel or sleeve to one side of the splice.

(3) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8 inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B26.
b. Removable railing sections: Provide removable railing sections as indicated.

2.11 SAFETY CHAINS AND GUARDRAILS

Provide safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Provide corrugated sheet steel beam guardrail conforming to the requirements of AASHTO M 180 of the class specified on the drawings. Provide bolts and nuts as indicated, conforming to the requirements of ASTM A307. Locate guard rails and safety chain where indicated.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel stair railing and hand rail work:

a. Structural steel plates, shapes, and bars
b. Structural steel tubing
c. Hot-Rolled carbon steel bars
d. Cold-Drawn steel tubing
e. Protective coating
f. Masonry anchorage devices
g. Steel railings and handrails
h. Aluminum railings and handrails
i. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

3.2 PREPARATION

Adjust stair railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8 feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard weight, steel pipe, not less than 6 inches long, and having an inside diameter not less than 1/2-inch greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 1-inch greater.
than the outside diameter of the sleeve. After posts have been
inserted into sleeves, fill the annular space between post and sleeve
with molten lead, sulfur, or a quick-setting hydraulic cement. Cover
anchorage joint with a round steel flange welded to the post.

Anchor posts to steel with steel oval flanges, angle type or floor
type as required by conditions, welded to posts and bolted to the
steel supporting members.

Anchor rail ends into concrete and masonry with steel round flanges
welded to rail ends and anchored into the wall construction with lead
expansion shields and bolts.

Anchor rail ends to steel with steel oval or round flanges welded to
tail ends and bolted to the structural steel members.

Secure handrails to walls by means of wall brackets and wall return
fitting at handrail ends. Provide brackets of malleable iron castings,
with not less than 3-inch projection from the finish wall surface to the
center of the pipe drilled to receive one 3/8-inch bolt. Locate brackets
not more than 60 inches on center. Provide wall return fittings of cast
iron castings, flush-type, with the same projection as that specified for
wall brackets. Secure wall brackets and wall return fittings to building
construction as follows:

For concrete and solid masonry anchorage, use bolt anchor expansion
shields and lag bolts.

For hollow masonry and stud partition anchorage, use toggle bolts
having square heads.

Install toe boards and brackets where indicated. Make splices, where
required, at expansion joints. Install removable sections as indicated.

3.3 STEEL HANDRAIL

Install in pipe sleeves embedded in concrete and filled with non-shrink
grout or quick setting anchoring cement with anchorage covered with
standard pipe collar pinned to post by means of base plates bolted to
strings or structural steel frame work. Secure rail ends by steel pipe
flanges anchored by expansion shields and bolts.

3.4 ALUMINUM HANDRAIL

Affix to base structure by base plates or flanges bolted to stringers or
structural steel framework. Provide Series 300 stainless steel bolts to
anchor aluminum alloy flanges, of a size appropriate to the standard
product of the manufacturer. Where aluminum or alloy fittings or
extrusions are to be in contact with dissimilar metals or concrete, coat
the contact surface a heavy coating of bituminous paint.

3.5 FIELD WELDING

Ensure procedures of manual shielded metal arc welding, appearance and
quality of welds made, and methods used in correcting welding work comply
with AWS D1.1/D1.1M.
3.6 TOUCHUP PAINTING

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --
PART 1 GENERAL

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   1.1.2 Sequencing
   1.1.3 Submittals Requirements
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   3.2.2 Data and Communication Cabling
3.3 INSPECTION
   3.3.1 General Requirements
   3.3.2 Inspection Standards

-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

1.1.1   General

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.1.2   Sequencing

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.1.3   Submittals Requirements

a. Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or
construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

b. Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification from UL of passing the "Aging and Environmental Exposure Testing" portion of UL 1479.

c. Submit documentation of training and experience for Installer.

d. Submit manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM E2174 (2010a; E 2011) Standard Practice for On-Site Inspection of Installed Fire Stops


1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Firestopping Materials; G

SD-07 Certificates
   Firestopping Materials
   Installer Qualifications
   Inspection

1.5 QUALITY ASSURANCE

1.5.1 Installer

   Engage an experienced Installer who is:

   a. FM Research approved in accordance with FM AS 4991, operating as a UL Certified Firestop Contractor, or

   b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer written certification of training, and retain proof of certification for duration of firestop installation.
1.5.2 Manufacturer's Technical Representative

The manufacturer's technical representative shall be a direct representative of the manufacturer (not a distributor or an agent). Provide current documentation from the manufacturer that he or she is a direct representative of the manufacturer and is qualified to perform the specified inspections and certify the firestopping installation.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements. Remove damaged or deteriorated materials from the site.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic, water-based, noncombustible products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment. Firestop material must be free from Ethylene Glycol, PCB, MEK, or other types of hazardous chemicals.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph "SCOPE", shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as follows:

b. Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = one hour, T Rating = one hour. Where the penetrating item is outside of a wall cavity the F rating and T rating must be equal to the fire resistance rating of the floor penetrated.

c. Penetrations of Fire and Smoke Resistance Rated Walls, Floors, Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = one hour, T Rating = one hour and L Rating = <5 cfm/sf.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph "SCOPE", and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E1399 or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.1.4 Material Performance

All firestop materials are subject to these minimum standards of performance.

a. Firestop material shall be capable of installation at temperatures of 35 to 120 degrees F.

b. Material must be able to be frozen, thawed and still maintain manufacturer approval for installation.

c. Firestop material must convey a manufacturer's written warranty guaranteeing the performance of the material for the sustainable lifetime of the structure.

d. Material must maintain a shelf life of no less than two years from date of manufacturing.

e. Acceptable firestop cast-in-place devices are factory assembled intumescent lined round or oval plastic cylinders capable of protecting plastic, metallic, cable, and blank openings through the cast-in-place device equal to the fire-resistance rating of the floor.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound.
3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products. Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <5 cfm/sf measured at ambient temperature and 400 degrees F at 0 percent to 100 percent visual fill. Each device must be capable of retrofit applications and be available in square and round configurations, with single, double, triple and six-plex bracket systems provided. Firestop devices must also allow for plastic pipe, metallic pipe, and mixed multiple penetrations plastic, metallic, insulated metallic, and cable through a single device.
3.3 INSPECTION

3.3.1 General Requirements

For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.2 Inspection Standards

Inspect all firestopping in accordance to ASTM standards for firestop inspection, and document inspection results to be submitted to GC, Architect and Owner.

a. ASTM E2393

b. ASTM E2174

-- End of Section --
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DIVISION 08 - OPENINGS

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STEEL DOORS AND FRAMES

02/10

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PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)


ASTM E283 (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115 (2006) Hardware Preparation in Steel Doors and Steel Frames

STEEL DOOR INSTITUTE (SDI/DOOR)


SDI/DOOR 113 (2001; R2006) Standard Practice for Determining the Steady State Thermal
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

SD-04 Samples
Factory-applied enamel finish

Where colors are not indicated, submit manufacturer's standard colors and patterns for selection.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Standard Duty Doors

SDI/DOOR A250.8, Level 1, physical performance Level C, Model 2, of size(s) and design(s) indicated and core construction as required by the manufacturer. Provide where shown.

2.1.1.2 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer for exterior doors, of size(s) and design(s) indicated.

2.2 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

2.3 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 3, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, unless otherwise indicated.
2.3.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.3.2 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.3.3 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.3.4 Terminated Stops

Where indicated, terminate interior door frame stops 2 inch above floor.

2.3.5 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.3.6 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.3.6.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

   a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

   b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames;

   c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

2.3.6.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each
2.4 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.4.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08 71 00 DOOR HARDWARE. Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283.

2.5 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.6 FINISHES

2.6.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8.

2.6.2 Factory-Applied Enamel Finish

Coatings shall meet test procedures and acceptance criteria in accordance with SDI/DOOR A250.3. After factory priming, apply two coats of low-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements shall be in accordance with the coating manufacturer's recommendations. Color(s) of finish coat shall be as indicated and shall match approved color sample(s).

2.7 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.
2.7.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --
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3.3.1 Maintenance and Adjustment
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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures

ASME INTERNATIONAL (ASME)

ASME B29.400 (2001; R 2008) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)


ASTM A653/A653M (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A780/A780M (2009) Standard Practice for Repair of
Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2013) Standard for Fire Doors and Other Opening Protectives

UNDERWRITERS LABORATORIES (UL)


1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Overhead Coiling Doors; G
   Manual Door Operators
   Electric Motor Operator; G
   Bottom Bars
   Guides
   Overhead Drum
   Hood
   Installation Drawings; G

SD-03 Product Data
   Overhead Coiling Doors; G
   Hardware
1.4 OVERHEAD COILING DOOR DETAIL SHOP DRAWINGS

Provide installation drawings for overhead coiling door assemblies which show: elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Show locations of replaceable fusible links on wiring diagrams for power, signal and controls. Include a schedule showing the location of each door with the drawings.

1.5 WARRANTY, OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

- Materials
- Devices
- Manual Door Operators
- Electric Door Operators
- Hood
- Counterbalancing Mechanism
- Painting
- Procedures
- Manufacturer's Brochures
Parts Lists

Furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two (2) years after completion and acceptance of the project.

Warrant that upon notification by the Government, any defects in material, workmanship, and door operation are immediately correct within the same time period covered by the guarantee, at no cost to the Government.

1.6 DELIVERY AND STORAGE

Deliver doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in an adequately ventilated dry location that is free from dirt and dust, water, or other contaminants. Store in a manner that permits easy access for inspection and handling.

PART 2 PRODUCTS

2.1 DESCRIPTION

Doors to be coiling type, with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated. Use grease-sealed or self-lubricating bearings for rotating members.

Provide oversized fire-rated door assemblies with a listing agency oversize label, or a certificate signed by an official of the manufacturing company certifying that the door and operator are designed to meet the specified requirements.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressure of at least 50 pounds per square foot with a maximum deflection of 1/120 of the opening width. Provide test data showing compliance with ASTM E330. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested. Ensure complete assembly meets or exceeds the requirements of ASCE 7.

2.2.2 Fire-Rated Doors, Frames, and Hardware

Provide fire-rated doors, frames, and hardware that are tested, rated, and labeled in accordance with Underwriters Laboratories, Factory Mutual or Warnock Hersey. Indicate on the labels the rating in hours, per NFPA 80, of fire exposure duration. Additionally, ensure a letter follows the hourly rating to designate the location for which the assembly is designed and the temperature rise on the unexposed door face at the end of 30 minutes of fire exposure is required.

Provide and attach metal UL labels to each item of hardware in accordance with requirements specified in the UL Bld Mat Dir.

2.2.3 Oversized Coiling Fire-rated Door Assemblies

Where fire-rated doors and frames exceed the size for which testing and
labeling services are offered, furnish certificates of inspection from either UL, Factory Mutual or Warnock Hersey. State within certificates that except for size, doors, frames, and hardware are identical in design, materials, and construction to a door that has been tested and rated.

2.2.4 Operational Cycle Life

Design all portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue to operate through a minimum number of 30,000 cycles per. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

2.3 OVERHEAD COILING DOORS

2.3.1 Curtain Materials and Construction

Provide curtain slats fabricated from Grade A steel sheets conforming to ASTM A653/A653M, with the additional requirement of a minimum yield point of 33,000 psi. Provide sheets, galvanized in accordance with ASTM A653/A653M and ASTM A924/A924M.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Ensure the provided slats are continuous without splices for the width of the door.

2.3.2 Curtain Bottom Bar

Install curtain bottom bars as pairs of angles from the manufacturer's standard steel not less than 2.0 by 2.0 inches by 0.188 inch. Ensure steel extrusions conform to ASTM A36/A36M. Galvanize angles and fasteners in accordance with ASTM A653/A653M and ASTM A924/A924M. Coat welds and abrasions with paint conforming to ASTM A780/A780M.

2.3.3 Locks

Provide end and/or wind locks of Grade B cast steel conforming to ASTM A27/A27M, galvanized in accordance with ASTM A653/A653M, ASTM A153/A153M and ASTM A924/A924M. Secure locks at every other curtain slat.

2.3.4 Weather Stripping

Ensure weather-stripping at the door-head and jamb is 1/8-inch thick sheet of natural or neoprene rubber with air baffles. Secure weather stripping to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inch wide and 1/8-inch thick.

Ensure threshold weather-stripping is 1/8-inch thick sheet natural or neoprene rubber secured to the bottom bars.

Provide weather-stripping of natural or neoprene rubber conforming to ASTM D2000.

2.3.5 Locking Devices

Ensure slide bolt engages through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
Provide a locking device assembly which includes cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

Provide chain lock keeper which suitable for a standard padlock.

2.3.6 Safety Interlock

Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.3.7 Overhead Drum

Fabricate drums from nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.

2.3.8 Slats

No. 5F, 18 gauge, Grade 40 steel, ASTM A653/A653M galvanized steel zinc coating.

2.4 HARDWARE

Ensure all hardware conforms to ASTM A153/A153M, ASTM A307, ASTM F568M, and ASTM A27/A27M.

2.4.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated. Provide guides with sufficient depth and strength to retain curtain, and to withstand loading. Ensure curtain operates smoothly. Slot bolt holes for track adjustment.

Ensure guides are roll-formed steel channel bolted to angle or structural grade, three angle assembly of stainless steel to form a slot of sufficient depth to retain curtains in guides to achieve 20 psf windload standard. Guides may be provided with integral windlock bars and removable bottom bar stops.

Fabricate with structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Flare the top of inner and outer guide angles outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.

2.4.2 Equipment Supports

Fabricate door-operating equipment supports from the manufacturer's standard steel shapes and plates conforming to ASTM A36/A36M, galvanized in accordance with ASTM A653/A653M and ASTM A924/A924M. Size the shapes and plates in accordance with the industry standards for the size, weight, and type of door installation.

2.4.3 Hood

Provide a hood with a minimum 24-gauge galvanized sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal
stiffness. The hood encloses the curtain coil and counterbalance mechanism.

2.5 COUNTERBALANCING MECHANISM

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted, around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.5.1 Brackets

Provide the manufacturer's standard mounting brackets with one located at each end of the counterbalance barrel conforming to ASTM A48/A48M. Provide brackets of either cast iron or cold-rolled steel.

2.5.2 Counterbalance Barrels

Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A53/A53M. Ensure the barrel is of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats. Limit barrel deflection to not more than 0.03 inch per foot of span under full load.

Curtain to be coiled on a pipe of sufficient size to carry door load with deflection not to exceed 0.033 inches per foot of door span and to be correctly balanced by helical springs, oil tempered torsion type. Use cast iron barrel plugs to anchor springs to tension shaft and pipe.

2.5.2.1 Barrel

Provide steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.

2.5.2.2 Spring Balance

Provide an oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door. Ensure that effort to operate manually operated units does not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.

2.6 MANUAL DOOR OPERATORS

2.6.1 Manual Push-Up Door Operators

Equip door with manufacturer's recommended lifting handles, locks, and latches. Adjust counterbalance mechanisms so that the required lift or pull for operation does not exceed 25 pounds unless another type of door operator is indicated. Design operating mechanisms so that the curtain can be stopped at any point in its upward or downward travel and remains in that position until pushed to the fully open or closed position.

2.6.2 Manual Chain-Hoist Door Operators

Provide door operators which consist of an endless steel hand chain, chain-pocket wheel, guard, and a geared reduction unit of at least a 3 to 1 ratio with a maximum lifting force of 25 lbf. Required pull for
operation cannot exceed 35 pounds.

Provide chain hoists with a self-locking mechanism allowing the curtain to be stopped at any point in its upward or downward travel and to remain in that position until moved to the fully open or closed position. Provide hand chains of cadmium-plated alloy steel conforming to ASME B29.400. Ensure yield point of the chain is at least three times the required hand-chain pull.

Provide chain sprocket wheels of cast iron conforming to ASTM A48/A48M.

2.7 ELECTRIC MOTOR OPERATOR

Rolling steel door unit shall be provided with a compact unit requiring a minimum of side clearance similar to Overhead Door's Model RG Operator or approved equal. The motor operator shall be 120 volt, single-phase, 60 Hz, motor, minimum 1/2 H.P. Unit shall be controlled by momentary contact, three-button pushbuttons marked "Open", "Close", "Stop", starter and an automatic screw-type limit switch which will break the circuit at termination of travel. Bottom bars shall be fitted with a combination electrically actuated safety device and weatherseal.

2.8 SURFACE FINISHING

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 GENERAL

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, ensure doors are free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the contract documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.2 FIELD PAINTED FINISH

Ensure field painted steel doors and frames are in accordance with Section 09 90 00 PAINTS AND COATINGS and manufacturer's written instructions. Protect weather stripping from paint. Ensure finishes are free of scratches or other blemishes.

3.3 ACCEPTANCE PROVISIONS

After installation, adjust hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth
operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to manufacturer's written instructions.

Test the door opening and closing operation when activated by controls or alarm-connected fire-release system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset door-closing mechanism after successful test.

Test and make final adjustment of new doors at no additional cost to the Government.

3.3.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, examine, lubricate, test, and re-adjust doors as required for proper operation.

3.3.2 CLEANING

Clean galvanized steel doors in accordance with manufacturer's approved instructions.

3.4 OPERATION AND MAINTENANCE

Submit six (6) copies of the Operation and Maintenance Manuals at least 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Provide test data that is legible and of good quality.

-- End of Section --
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DIVISION 08 - OPENINGS

SECTION 08 71 00

DOOR HARDWARE

08/08

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3.4 KEY CABINET AND CONTROL SYSTEM
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3.6 HARDWARE SETS

-- End of Section Table of Contents --
PART 1  GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

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ASTM INTERNATIONAL (ASTM)

ASTM E283 (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen


BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1 (2006) Butts and Hinges
ANSI/BHMA A156.12 (2005) Interconnected Locks & Latches
ANSI/BHMA A156.13 (2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16 (2008) Auxiliary Hardware
ANSI/BHMA A156.18 (2006) Materials and Finishes
ANSI/BHMA A156.2 (2011) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21 (2009) Thresholds
ANSI/BHMA A156.3 (2008) Exit Devices
ANSI/BHMA A156.4 (2008) Door Controls - Closers
ANSI/BHMA A156.5 (2010) Auxiliary Locks and Associated Products
ANSI/BHMA A156.6 (2010) Architectural Door Trim
ANSI/BHMA A156.7 (2003; R 2009) Template Hinge Dimensions
ANSI/BHMA A156.8 (2010) Door Controls - Overhead Stops and Holders
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardware schedule; G

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.4 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

TABLE 1 - Exterior safety/security doors at the Head Works and Pump Station
### 1.5 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Government Representative prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

### 1.6 QUALITY ASSURANCE

#### 1.6.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

#### 1.6.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Government Representative, Contractor, Door Hardware subcontractor, shall meet to discuss key requirements for the facility.

### 1.7 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys to the Government Representative, either directly or by certified mail. Deliver construction master keys with the locks.

### PART 2 PRODUCTS

#### 2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors
manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Government Representative.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.1.1 Protection Devices

Provide full height hand and finger protection device at the hinge-side area opening of doors and gates. Hinge-side protection device shall be provided on both sides of the doors and gates, covering hinges and space between door and frame when doors are in the open position. The installed device shall push hand and/or fingers out of the opening and away from a crushing hazard.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.2.2 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1.

2.3.2.3 Interconnected Locks and Latches

ANSI/BHMA A156.12. Provide F96 or F97, unless otherwise specified.

2.3.2.4 Auxiliary Locks

ANSI/BHMA A156.5, Grade 1.
2.3.3 Exit Devices

ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices.

2.3.4 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with minimum of six pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer.

2.3.5 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.5.1 Knobs and Roses

Conform to the minimum test requirements of ANSI/BHMA A156.2 and ANSI/BHMA A156.13 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide 0.050 inch thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch, except for knob shanks, which are 0.060 inch thick.

2.3.5.2 Lever Handles

Provide lever handles in lieu of knobs. Conform to the minimum requirements of ANSI/BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.5.3 Texture

Provide knurled or abrasive coated knobs or lever handles for doors which lead to dangerous areas.

2.3.6 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Stamp each key with appropriate key control symbol. Do not place room number on keys.

2.3.7 Door Bolts


2.3.8 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with
manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.8.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.9 Overhead Holders

ANSI/BHMA A156.8.

2.3.10 Closer Holder-Release Devices

BHMA A156.15.

2.3.11 Door Protection Plates

ANSI/BHMA A156.6.

2.3.11.1 Sizes of Kick Plates

2 inch less than door width for single doors. Provide 8 inch kick plates.

2.3.12 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.13 Padlocks

ASTM F883.

2.3.14 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.15 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals. Air leakage of weather stripped doors not to exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weather stripping with one of the following:

2.3.15.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide anodized aluminum.

2.3.15.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.
2.3.15.3  Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

2.3.16  Rain Drips

Extruded aluminum, not less than 0.08 inch thick, anodized. Set drips in sealant and fasten with stainless steel screws.

2.3.16.1  Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.16.2  Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.17  Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4  FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.5  FINISHES

ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except prime coat finish for surface door closers, and except BHMA 652 finish (satin chromium plated) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

PART 3  EXECUTION

3.1  INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1  Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full
contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 1 inch on center and to heads and jambs at 4 inch on center.

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.


b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Government Representative. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Government Representative. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.
### HINGE SIZES CHART

<table>
<thead>
<tr>
<th>Thickness of Doors in inches</th>
<th>Width of Doors in inches</th>
<th>Height of Hinges (Length of Joint) in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8 to 1-1/8 screen</td>
<td>To 36</td>
<td>3</td>
</tr>
<tr>
<td>1-3/8</td>
<td>To 32</td>
<td>3-1/2</td>
</tr>
<tr>
<td>1-3/8</td>
<td>Over 32 to 37</td>
<td>4</td>
</tr>
<tr>
<td>1-3/4</td>
<td>To 36</td>
<td>4-1/2</td>
</tr>
<tr>
<td>1-3/4</td>
<td>Over 36 to 48</td>
<td>5 (Heavy Weight)</td>
</tr>
<tr>
<td>1-3/4</td>
<td>Over 48</td>
<td>6 (Heavy Weight)</td>
</tr>
<tr>
<td>2, 2-1/4 and 2-1/2</td>
<td>To 42</td>
<td>5 (Heavy Weight)</td>
</tr>
<tr>
<td>2, 2-1/4 and 2-1/2</td>
<td>Over 42</td>
<td>6 Heavy Weight</td>
</tr>
</tbody>
</table>

-- End of Section --
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D  (2012) Laboratory Methods of Testing Dampers for Rating

AMCA 511  (2010) Certified Ratings Program for Air Control Devices

ALUMINUM ASSOCIATION (AA)

AA DAF45  (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


ASTM INTERNATIONAL (ASTM)

ASTM A653  (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


1.3  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings

Wall louvers; G

SD-03 Product Data

Metal Wall Louvers; G

SD-04 Samples

Wall louvers
Door louvers

1.4 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.5 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.6 COLOR SAMPLES

Colors of finishes for wall louvers and door louvers shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Government Representative for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

ASTM A653, coating designation G90.

2.1.2 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 70 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.
2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Formed Metal Louvers

Formed of zinc-coated steel sheet not thinner than 16 U.S. gage, or aluminum sheet not less than 0.08 inch thick.

2.2.3 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions where indicated. Provide mullions covers on both faces of joints between louvers.

2.2.4 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. For steel louvers, provide 1/2 inch square mesh, 12 or 16 gage zinc-coated steel; 1/2 inch square mesh, 16 gage copper; or 1/4 inch square mesh, 16 gage zinc-coated steel or copper bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 DOOR LOUVERS

Inverted "Z" sightproof type not less than one inch thick with matching metal trim. Louvers for exterior doors shall be weather resistant type.

2.3.1 Extruded Aluminum Door Louvers

Fabricate of 6063-T5 or -T52 aluminum alloy with a wall thickness of not less than 0.050 inch thick. Frames and trim shall be clamp-in "L" type.

2.3.2 Formed Metal Door Louvers

Fabricate of 20 U.S. gage steel sheet or sheet aluminum not less than 0.050 inch thick. Trim shall be beveled "Z" molding both sides.

2.3.3 Screens and Frames

For exterior doors, provide aluminum insect screens, 18 by 16 or 18 by 24 mesh. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.4 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.5 FINISHES

2.5.1 Aluminum

Exposed aluminum surfaces shall be factory finished with an anodic coating. Color shall be as indicated. Louvers shall have the same finish.
2.5.1.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF45 and AAMA 611. Finish shall be:

a. Architectural Class I (0.7 mil or thicker), designation AA-M10-C22, A42, integral color anodized.

2.5.2 Steel

Provide factory-applied coating. Clean and phosphate treat exposed surfaces and apply rust-inhibitive primer and baked enamel finish coat, one mil minimum total dry film thickness, color as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Door Louvers

Install louvers in wood doors by using metal "Z" or "L" moldings. Fasten moldings to door with screws.

3.1.3 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two (2) coats of aluminum paint or a coat of heavy-bodied bituminous paint.

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DIVISION 09 - FINISHES

SECTION 09 90 00

PAINTS AND COATINGS

05/11

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1.1  MEASUREMENT AND PAYMENT

   Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

   The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

   **AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)**

   ACGIH 0100 (2001; Supplements 2002-2008)
   Documentation of the Threshold Limit Values and Biological Exposure Indices

   **ASME INTERNATIONAL (ASME)**


   **ASTM INTERNATIONAL (ASTM)**


   ASTM D4263 (1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method


   ASTM F1869 (2011) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

   **MASTER PAINTERS INSTITUTE (MPI)**

   MPI 1 (Oct 2009) Aluminum Paint

   MPI 10 (Oct 2009) Exterior Latex, Flat, MPI Gloss Level 1
| MPI 101  | (Oct 2009) Epoxy Anti-Corrosive Metal Primer |
| MPI 107  | (Oct 2009) Rust Inhibitive Primer (Water-Based) |
| MPI 108  | (Oct 2009) High Build Epoxy Coating, Low Gloss |
| MPI 138  | (Oct 2009) Interior High Performance Latex, MPI Gloss Level 2 |
| MPI 139  | (Oct 2009) Interior High Performance Latex, MPI Gloss Level 3 |
| MPI 141  | (Oct 2009) Interior High Performance Latex MPI Gloss Level 5 |
| MPI 161  | (Oct 2009) Exterior W.B. Light Industrial Coating, MPI Gloss Level 3 |
| MPI 21   | (Oct 2009) Heat Resistant Enamel, Gloss (up to 205 degrees C and 400 degrees F), MPI Gloss Level 6 |
| MPI 23   | (Oct 2009) Surface Tolerant Metal Primer |
| MPI 26   | (Oct 2009) Cementitious Galvanized Metal Primer |
| MPI 27   | (Oct 2009) Exterior / Interior Alkyd Floor Enamel, Gloss |
| MPI 39   | (Oct 2009) Interior Latex-Based Wood Primer |
| MPI 45   | (Oct 2009) Interior Alkyd Primer Sealer |
| MPI 47   | (Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 |
| MPI 49   | (Oct 2009) Interior Alkyd, Flat, MPI Gloss Level 1 |
| MPI 51   | (Oct 2009) Interior Alkyd, Eggshell, MPI Gloss Level 2 |
| MPI 57   | (Oct 2009) Interior Oil Modified Urethane Clear Satin |
| MPI 7    | (Oct 2009) Exterior Oil Wood Primer |
| MPI 72   | (Oct 2009) Polyurethane, Two Component, |

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Pigmented, Gloss

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal Primer

MPI 8 (Oct 2009) Exterior Alkyd, Flat, MPI Gloss Level I

MPI 94 (Oct 2009) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5

MPI 95 (Oct 2009) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2000; E 2004) Shop, Field, and Maintenance Painting of Steel


SSPC SP 1 (1982; E 2004) Solvent Cleaning

SSPC SP 10/NACE No. 2 (2007) Near-White Blast Cleaning

SSPC SP 12/NACE No.5 (2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating


SSPC SP 3 (2004; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

SSPC SP 7/NACE No.4 (2007) Brush-Off Blast Cleaning


1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Certification

Coating; G
Manufacturer's Technical Data Sheets; (LEED)

Indicate VOC content.

SD-04 Samples

Color; G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

Textured Wall Coating System; G

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings; G

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.4  APPLICATOR'S QUALIFICATIONS

1.4.1  Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three (3) similar projects within the past three (3) years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

   Position or responsibility
Employer (if other than the Contractor)
Name of facility owner
Mailing address and telephone number of facility owner
Name of individual in facility owner's organization who can be contacted as a reference
Location, size and description of structure
Dates work was carried out
Description of work carried out on structure

1.4.2 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Government Representative of any change in contractor certification status.

1.5 QUALITY ASSURANCE

1.5.1 Field Samples and Tests

The Government Representative may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.5.1.1 Sampling Procedure

The Government Representative will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Government Representative, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.5.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality
Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 5 by 7 inches and of sufficient size to show pattern repeat and texture.

1.5.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, a minimum 8 foot by 8 foot mock-up shall be provided for each substrate and for each color and type of textured wall coating, using the actual substrate materials. Once approved the mock-up samples shall be used as a standard of workmanship for installation within the facility. At least 48 hours prior to mock-up installation, the Contractor shall submit written notification to the Government Representative.

1.6 REGULATORY REQUIREMENTS

1.6.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify the Government Representative of any paint specified herein which fails to conform.

1.6.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.
1.6.4 Asbestos Content

Materials shall not contain asbestos.

1.6.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.6.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.6.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.7 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.8 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable Manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.
c. ACGIH 0100, threshold limit values.

1.9 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Government Representative and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.9.3 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs.

1.10 COLOR SELECTION

Color Coding For Shore-To-Ship Utility Connections: Paint hose connection fittings and shut-off valves the designated color. In addition to color coding provide 2 inch high stenciled letters using black stencil paint, clearly designating service for each connection.

<table>
<thead>
<tr>
<th>Service</th>
<th>Color</th>
<th>FED-STD-595 No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable Water*</td>
<td>Blue</td>
<td>15044</td>
</tr>
<tr>
<td>Water Provided for Fire Protection**</td>
<td>Red</td>
<td>11105</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>Striped Blue/White</td>
<td>15044/17886</td>
</tr>
<tr>
<td>Oily Waste Water</td>
<td>Striped Yellow/Black</td>
<td>13538/17038</td>
</tr>
</tbody>
</table>

SECTION 09 90 00 Page 11
Color Coding for Shore-to-Ship Utility Connections

<table>
<thead>
<tr>
<th>Service</th>
<th>Color</th>
<th>FED-STD-595 No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer</td>
<td>Gold</td>
<td>17043</td>
</tr>
<tr>
<td>Steam</td>
<td>White</td>
<td>17886</td>
</tr>
<tr>
<td>High Pressure Air</td>
<td>Gray</td>
<td>16081</td>
</tr>
<tr>
<td>Low Pressure Air</td>
<td>Tan</td>
<td>10324</td>
</tr>
<tr>
<td>Fuel</td>
<td>Yellow</td>
<td>13655</td>
</tr>
</tbody>
</table>

* This includes connections serving domestic functions.

** This includes non-potable salt water or, at some locations, fresh water connections provided for fire protection (may also include flushing and cooling requirements). Note: This does not include waterfront fire hydrants.

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Government Representative. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

1.11.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.11.1.1 Exterior Painting

Includes new surfaces of the building and appurtenances.

1.11.1.2 Interior Painting

Includes new surfaces of the building and appurtenances as indicated. Where a space or surface is indicated to be painted, include the following
items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and
b. Other contiguous surfaces.

1.11.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.11.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;
(2) Supports, hangers, air grilles, and registers;
(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation
(2) New aluminum jacket on piping
(3) New interior ferrous piping under insulation.

1.11.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of
red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

1.11.4 MISCELLANEOUS PAINTING

Lettering Building Room Number

Lettering shall be provided as scheduled on the drawings, shall be Gothic type, and shall be black enamel. Samples shall be approved before application.

1.11.5 Definitions and Abbreviations

1.11.5.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.11.5.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.11.5.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.11.5.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.11.5.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.
1.11.5.6  EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.11.5.7  EXT

MPI short term designation for an exterior coating system.

1.11.5.8  INT

MPI short term designation for an interior coating system.

1.11.5.9  micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.11.5.10  mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.11.5.11  mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.11.5.12  MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

<table>
<thead>
<tr>
<th>Gloss Level</th>
<th>Description</th>
<th>Units at 60 degrees</th>
<th>Units at 85 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>Matte or Flat</td>
<td>0 to 5</td>
<td>10 max</td>
</tr>
<tr>
<td>G2</td>
<td>Velvet</td>
<td>0 to 10</td>
<td>10 to 35</td>
</tr>
<tr>
<td>G3</td>
<td>Eggshell</td>
<td>10 to 25</td>
<td>10 to 35</td>
</tr>
<tr>
<td>G4</td>
<td>Satin</td>
<td>20 to 35</td>
<td>35 min</td>
</tr>
<tr>
<td>G5</td>
<td>Semi-Gloss</td>
<td>35 to 70</td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>Gloss</td>
<td>70 to 85</td>
<td></td>
</tr>
<tr>
<td>G7</td>
<td>High Gloss</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.11.5.13  MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.
1.11.5.14 Paint

See Coating definition.

1.11.5.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.11.5.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents. Minimum 20 percent post-consumer recycled content for the following light-colored paints and primers. Minimum 50 percent post-consumer recycled content for the following dark-colored paints and primers. All consolidated latex paints shall contain a minimum of 100 percent post-consumer recycled content. Comply with applicable regulations regarding toxic and hazardous materials.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and

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grease. Where shop coat is missing or damaged, clean according to SSPC SP 2 or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC SP 7/NACE No.4. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3/SSPC SP 12/NACE No.5 WJ-3.

c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10/NACE No. 2.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No.2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12/NACE No.5. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4/NACE VIS 7.

3.3.3 Galvanized Surfaces

a. New Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized". If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

b. Galvanized With Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12/NACE No.5 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12/NACE No.5 WJ3 degree of cleanliness.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.
3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.3.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when
measured in accordance with ASTM D4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

   Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Government Representative prior to receiving paint or other finish. Do not use water to clean uncoated wood.

b. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D4444, Method A, unless otherwise authorized.

c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

e. Cosmetic Repair of Minor Defects:

   (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

   (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

   (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

f. Prime Coat For New Exterior Surfaces: Prime coat wood doors, windows, frames, and tri before wood becomes dirty, warped, or weathered.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with manufacturer's application instructions and SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be
of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Government Representative to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause
the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

| Division 5. | Exterior Metal, Ferrous and Non-Ferrous Paint Table |
| Division 6. | Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table |
| Division 5. | Interior Metal, Ferrous and Non-Ferrous Paint Table |
| Division 6. | Interior Wood Paint Table |
| Division 9: | Interior Plaster, Gypsum Board, Textured Surfaces Paint Table |

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.9 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by ASME A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.10 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Government Representative. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.11 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials.
3.12 PAINT TABLES

All DFT's are minimum values. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd
   New; MPI EXT 5.1Q-G5 (Semigloss)
   Primer:             Intermediate:       Topcoat:
   MPI 23               MPI 94             MPI 94
   System DFT:   5.25 mils

B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3:

2. Alkyd
   New; MPI EXT 5.1D-G5 (Semigloss)
   Primer:             Intermediate:       Topcoat:
   MPI 79               MPI 94             MPI 94
   System DFT:   5.25 mils

C. New steel blast cleaned to SSPC SP 10/NACE No. 2:

1. Waterborne Light Industrial
   MPI EXT 5.1R-G5 (Semigloss)
   Primer:             Intermediate:       Topcoat:
   MPI 101               MPI 108           MPI 163
   System DFT:   8.5 mils

2. Pigmented Polyurethane
   MPI EXT 5.1J-G6 (Gloss)
   Primer:             Intermediate:       Topcoat:
   MPI 101               MPI 108           MPI 72
   System DFT:   8.5 mils

D. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Enamel
   MPI EXT 5.1S-G6 (Gloss)
   Primer:             Intermediate:       Topcoat:
   MPI 79               MPI 27             MPI 27 (plus NSA)
   System DFT:   5.25 mils

EXTERIOR GALVANIZED SURFACES

E. New Galvanized surfaces:

1. Cementitious primer / Latex
   MPI EXT 5.3A-G1 (Flat)
EXTERIOR GALVANIZED SURFACES
Primer: MPI 26 Intermediate: MPI 10 Topcoat: MPI 10
System DFT: 4.5 mils

MPI EXT 5.3A-G5 (Semigloss)
Primer: MPI 26 Intermediate: MPI 11 Topcoat: MPI 11
System DFT: 4.5 mils

2. Epoxy Primer / Waterborne Light Industrial Coating
MPI EXT 5.3K-G5 (Semigloss)
Primer: MPI 101 Intermediate: MPI 163 Topcoat: MPI 163
System DFT: 5 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)
G. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
MPI EXT 5.4F-G1 (Flat)
Primer: MPI 95 Intermediate: MPI 8 Topcoat: MPI 8
System DFT: 5 mils

MPI EXT 5.4F-G5 (Semigloss)
Primer: MPI 95 Intermediate: MPI 94 Topcoat: MPI 94
System DFT: 5 mils

H. Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
MPI EXT 5.1D-G1 (Flat)
Primer: MPI 79 Intermediate: MPI 8 Topcoat: MPI 8
System DFT: 5.25 mils

MPI EXT 5.1D-G5 (Semigloss)
Primer: MPI 79 Intermediate: MPI 94 Topcoat: MPI 94
System DFT: 5.25 mils

2. Waterborne Light Industrial Coating
MPI EXT 5.1C-G3(Eggshell)
Primer: MPI 79 Intermediate: MPI 161 Topcoat: MPI 161
System DFT: 5 mils

MPI EXT 5.1C-G5(Semigloss)
Primer: MPI 79 Intermediate: MPI 163 Topcoat: MPI 163

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EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)
System DFT: 5 mils

I. Hot metal surfaces subject to temperatures up to 400 degrees F:

1. Heat Resistant Enamel
   MPI EXT 5.2A
   Primer: Intermediate: Topcoat:
   MPI 21 Surface preparation and number of coats per manufacturer's instructions.
   System DFT: Per Manufacturer

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES
PAINT TABLE

A. New Dressed lumber, Wood and plywood, trim, including top, bottom and edges of doors not otherwise specified:

1. Alkyd
   MPI EXT 6.3B-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 94 MPI 94
   System DFT: 5 mils

2. Latex
   MPI EXT 6.3A-G1 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 10 MPI 10
   System DFT: 5 mils

   MPI EXT 6.3A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 11 MPI 11
   System DFT: 5 mils

3.12.2 INTERIOR PAINT TABLES

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex
   MPI INT 5.1R-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 138 MPI 138
   System DFT: 5 mils

   MPI INT 5.1R-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 141 MPI 141
   System DFT: 5 mils
INTERIOR STEEL / FERROUS SURFACES

2. Alkyd
   MPI INT 5.1E-G2 (Flat)
   Primer:             Intermediate:       Topcoat:
   MPI 79             MPI 49            MPI 49
   System DFT:   5.25 mils

   MPI INT 5.1E-G5 (Semigloss)
   Primer:             Intermediate:       Topcoat:
   MPI 79             MPI 47            MPI 47
   System DFT:   5.25 mils

B. Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces as follows:

1. Aluminum Paint
   MPI INT 5.1M
   Primer:             Intermediate:       Topcoat:
   MPI 79             MPI 1            MPI 1
   System DFT:   4.25 mils

C. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. High Performance Architectural Latex
   MPI INT 5.4F-G2 (Flat)
   Primer:             Intermediate:       Topcoat:
   MPI 95             MPI 138           MPI 138
   System DFT:   5 mils

2. Alkyd
   MPI INT 5.4J-G2 (Flat)
   Primer:             Intermediate:       Topcoat:
   MPI 95             MPI 49            MPI 49
   System DFT:   5 mils

   MPI INT 5.4J-G5 (Semigloss)
   Primer:             Intermediate:       Topcoat:
   MPI 95             MPI 47            MPI 47
   System DFT:   5 mils

F. Hot metal surfaces subject to temperatures up to 400 degrees F:

1. Heat Resistant Enamel
   MPI INT 5.2A
   Primer:             Intermediate:       Topcoat:
   MPI 21             MPI 138           MPI 138
   Surface preparation and number of coats per manufacturer's instructions.
   System DFT:   Per Manufacturer

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New Wood and plywood not otherwise specified:

1. High Performance Architectural Latex
   MPI INT 6.4S-G3 (Eggshell)
DIVISION 6:  INTERIOR WOOD PAINT TABLE

Primer:             Intermediate:       Topcoat:
MPI 39             MPI 139             MPI 139
System DFT:       4.5 mils

MPI INT 6.4S-G5 (Semigloss)
Primer:             Intermediate:       Topcoat:
MPI 39             MPI 141             MPI 141
System DFT:       4.5 mils

2. Alkyd
   MPI INT 6.4B-G3 (Eggshell)
   Primer:             Intermediate:       Topcoat:
   MPI 45             MPI 51             MPI 51
   System DFT:       4.5 mils

   MPI INT 6.4B-G5 (Semigloss)
   Primer:             Intermediate:       Topcoat:
   MPI 45             MPI 47             MPI 47
   System DFT:       4.5 mils

B. New Wood and Plywood, except floors; natural finish or stained:

1. Natural finish, oil-modified polyurethane
   New; MPI INT 6.4J-G4
   Primer:             Intermediate:       Topcoat:
   MPI 57             MPI 57             MPI 57
   System DFT:       4 mils
   -- End of Section --
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DIVISION 09 - FINISHES

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

07/07

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


MASTER PAINTERS INSTITUTE (MPI)


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 7/NACE No.4 (2007) Brush-Off Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)


1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment and Fixture List in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items including manufacturer's name and identification. Data shall include detailed analysis of each special coating material required for the project, with all the coating constituents
measured as percentages of the total weight of the coating. Manufacturer's data concerning application, thinning, and average coverage per gallon shall be included.

Heat-Resistant Coatings
Epoxy Coatings
Polyurethane Coatings
Chlorinated-Rubber Coatings

SD-07 Certificates

Submit certificates for following items showing conformance with the referenced standards contained in this section.

Heat-Resistant Coatings
Epoxy Coatings
Polyurethane Coatings
Chlorinated-Rubber Coatings

1.4 DELIVERY, HANDLING AND STORAGE

Special coating materials must be delivered to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Special coating materials must be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Solvents, thinners, and equipment cleaners must be stored with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

Submit Material, Equipment and Fixture List consisting of a list of proposed equipment to be used in performance of construction work.

1.5 FIELD TESTS

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

1.6 PROTECTIONS AND SAFETY PRECAUTIONS

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Building materials and equipment must be left clean and with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching them with water and placing in a covered metal
1.7 QUALITY ASSURANCE

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

PART 2 PRODUCTS

2.1 HEAT-RESISTANT COATINGS

2.1.1 Category 1, 50 to 400 Degrees F

Coatings for surface temperatures not exceeding 400 degrees F must be alkyd resin-based material. Apply a minimum two coats of coating with a dry-film thickness of a minimum 4 mils.

First coat must be an epoxy zinc primer conforming to MPI ASM, No. 20 with the resin solids and zinc pigment not less than 80 percent of the total weight of the material.

White and color pigmented finish coats must be an alkyd resin-based material with the resin solids and pigments not less than 85 percent of the total weight of the material. Pigments must be heat-stable materials, formulated to colors as scheduled.

Black-pigmented finish coats must be an alkyd resin, carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum pigmented finish coats must be an alkyd resin-based material with resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.2 Category 2, 300 to 600 Degrees F

Coatings for surface temperatures not exceeding 600 degrees F must be based on modified silicone and silicone-based resins. Coatings must be applied in not less than two coats with a dry-film thickness of not less than 3 mils.

Provide a silicone-based resin zinc-pigmented material with the resin solids and zinc pigment for the first coat not less than 80 percent of the total weight of the material.

Color pigmented finish coats must be silicone-based resin material with the resin solids and pigments not less than 80 percent of the total weight of the material. Pigments must be heat-stable materials, formulated to colors as scheduled.

Black-pigmented finish coat must be a silicone-based resin carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum-pigmented finish coats must be modified, silicone-based-resin material with the resin solids and pigments not less than 50 percent of the total weight of the material.
2.1.3 Category 3, 600 to 800 Degrees F

Provide a modified silicone or a silicone-based material of coating for surface temperatures not exceeding 800 degrees F. Apply a minimum two coats with a dry-film thickness of a minimum.

Provide a silicone-based resin, zinc-pigmented material first coat with the resin solids and zinc pigment for the first coat not less than 80 percent of the total weight of the material.

Black-pigmented finish coat must be a silicone-based resin, carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum-pigmented finish coat must be a modified, silicone-based-resin material with the resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.4 Category 4, 800 to 1,200 Degrees F

Coatings for surface temperatures not exceeding 1,200 degrees F must be an aluminum-pigmented, silicone-resin-based material conforming to QPL-TNT-AP-28, as modified.

Apply a minimum two coats with a dry-film thickness of a minimum 2 mils.

Coating pigment must contain a minimum of 28 percent aluminum based on the total weight of the material. Vehicle must contain a minimum of 22 percent silicone resin and a maximum of 49 percent of volatile thinners and driers based on the total weight of the material.

2.2 EPOXY COATINGS

2.2.1 General

Conform to MPI ASM, No. 116 for epoxy coatings and epoxy block filler, as modified.

Vehicle resins for finish coats must be based on a polyamide-cured, epoxy-resin material. Apply finish coats with a dry-film thickness of not less than 4 mils per coat. Finish color and gloss must be as indicated.

2.2.2 Concrete Surface Coatings

Apply an epoxy coating system in conformance with MPI ASM, No. 77 for vertical concrete surfaces. Apply an epoxy slip-resistant deck coating system in conformance with MPI ASM, No. 82. Prime coat must fill concrete surface pores with a total dry-film thickness of not less than 2 mils.

2.2.3 Masonry Surfaces Coatings

Apply an Epoxy Coating System in conformance with MPI ASM, No. 77. Block filler must fill surface pores with a total dry-film thickness of not less than 7 mils.

2.2.4 Ferrous and Galvanized Metal Surface Coatings

Coatings on ferrous and galvanized metal surfaces must be a prime coat and not less than two finish coats. Comply with MPI ASM, No. 101 for an epoxy
zinc primer with a metallic-zinc pigment for the substrate to be coated and the end use of the coated surface. Resin solids and zinc pigment must not be less than 80 percent of the total weight of the coating material. Apply prime coat with a total dry-film thickness of not less than 4 mils. Provide an epoxy-based finished coat as specified.

2.2.5 Aluminum Surface Coatings

Apply an Epoxy Coating System in conformance with MPI ASM, No. 80 and MPI ASM, No. 77. Apply prime coat with a total dry-film thickness of not less than 4 mils.

2.3 POLYURETHANE COATINGS

2.3.1 General

Polyurethane coatings must conform to MPI ASM for each substrates indicated.

Vehicle resins for finish coats must be based on a two-part, prepolymer, catalytic-cured, polyurethane material. Apply catalytic-cured coatings with a total dry-film thickness of not less than 10 mils per coat. Indicate finish color and gloss on the schedules.

2.3.2 Concrete Surface Coatings

Apply a Polyurethane, Pigmented Coating System in conformance with MPI ASM, No. 72 and MPI ASM, No. 80. Prime coat must fill surface pores with a total dry-film thickness of not less than 2 mils. Finish coats must be a polyurethane-based material as specified.

2.3.3 Masonry Surface Coatings

Apply a Polyurethane, Clear, Two-Component Coating System in conformance with MPI ASM, No. 78. Block filler must fill surface pores with a total dry-film thickness of not less than 7 mils. Finish coats must be a polyurethane-based material as specified.

2.3.4 Ferrous and Galvanized Metal Surface Coatings

Apply a Polyurethane, Pigmented Coating System in conformance with MPI ASM, No. 72, MPI ASM, No. 77, and MPI ASM, No. 101. Apply prime coat with a dry-film thickness of not less than 2 mils. Finish coats must be a polyurethane-based material as specified.

2.3.5 Aluminum Surface Coatings

Apply a water base, light industrial coating system in conformance with MPI ASM, No. 95 coats on aluminum surfaces. Prime coat must use ASTM SI10 and or a polyurethane-resin material as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surfaces. Apply prime coat with a dry-film thickness of not less than 2 mils. Finish coats must be a polyurethane-based material as specified.

2.3.6 Wood Surface Coatings

Apply a pigmented polyurethane coating in conformance with MPI ASM, No. 72. Apply prime coat with a dry-film thickness of not less than 5 mils. Finish coats must be a polyurethane-based material as specified.
2.4 CHLORINATED-RUBBER COATINGS

2.4.1 General

Vehicle resins for finish coats must be based on a modified, chlorinated-rubber, phenolic-resin material. Coating material must contain not less than 20 percent chlorinated rubber resin, based on the total weight of the material. Apply finish coats with a dry-film thickness of not less than 3 mils per coat. Finish coating color must be as indicated.

2.4.2 Concrete Surface Coatings

Apply a minimum three coats on concrete surfaces. Prime coat must be based on a chlorinated-rubber resin material as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surfaces. Prime coat must fill concrete surface pores with a total film thickness of not less than 2 mils. Finish coats must be chlorinated-rubber-based coatings as specified.

2.4.3 Masonry Surface Coatings

Apply a minimum two finished coats on masonry surfaces must be a masonry block filler. Block filler must be based on an epoxy-ester resin material as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surface. Block filler must fill surface pores with a total film thickness of not less than 7 mils. Finish coats must be chlorinated-rubber-based coatings as specified.

2.4.4 Ferrous and Galvanized Metal Surface Coatings

Apply a minimum two coats of high performance architectural latex coating in conformance with MPI ASM, No. 79 on ferrous and galvanized metal surfaces. Apply prime coat with a dry-film thickness of not less than 3 mils. Finish coats must be chlorinated rubber-based coatings as specified.

2.4.5 Aluminum Surface Coatings

Apply a minimum three coats of quick drying primer for aluminum surfaces. Prime coat must conform to ASTM SI10 and MPI ASM, No. 80 for aluminum coating system.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Concrete Surfaces

Conform to MPI ASM for substrates indicated. Remove plates, machined surfaces, and similar items already in place that are not to be coated. Provide surface-applied protection before surface preparation and coating where removal is impractical or impossible. After completing coating operations, reinstall items that were removed.

Clean dirt, oil, grease, and incompatible paints from substrates to ensure bonding. Coordination of shop-applied prime coats with high-performance coatings is critical. Remove incompatible primers. Reprime substrate with compatible primers as required to produce coating systems indicated.
3.1.1.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk. Maximum Moisture Content of concrete is 12 percent. Moisture content must be measured with electronic moisture meter.

Clean surfaces with pressurized water. Use pressure range of 4000 psi at 6 inch to 12 inch.

Comply with SSPC SP 7/NACE No.4 (NACE No. 4), "Brush-Off Blast Cleaning" for abrasive cleaning.

3.1.1.2 Clay Masonry Substrates

Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 inch to 12 inch.

3.1.1.3 Steel Substrates

Remove rust and loose mill scale. Clean using methods recommended in writing by coating manufacturer. Conform to SSPC SP 7/NACE No.4 (NACE No. 4) for blast cleaning.

3.1.1.4 Galvanized-Metal Substrates

Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.1.1.5 Aluminum Substrates

Remove surface oxidation.

3.1.1.6 Wood Substrates

Prep substrates by scraping and cleaning small, dry, seasoned knot. Sand surfaces smooth. Apply a thin coat of knot sealer before applying an interior latex-based wood primer. Prime edges, ends, faces, undersides, and back sides of wood. After priming, fill holes and crevices to the finished surface with putty or plastic wood filler. After finished surface is dry, smooth surface by sanding. For a finished product.

3.2 COATING MATERIAL PREPARATION

3.2.1 General

Mix and prepare coating materials in accordance with the coating manufacturer's printed instructions for the particular material and coat to be applied. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker must be allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform
density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

3.2.2 Thinning

Thinning must be done in accordance with coating manufacturer's printed directions for the particular material and coat.

3.2.3 Tinting

Prime and intermediate coats of paint must be a slightly different tint from the finish coat to facilitate identification of each coat. Tinting must be done by the coating manufacturer and clearly identified as to color and coat.

3.3 APPLICATION OF COATING MATERIALS

3.3.1 General

Do not perform exterior painting in damp or rainy weather. Interior painting must not be allowed until the building is enclosed and has thoroughly dried out. Do not allow painting below 50 degrees F and above 95 degrees F. Painting application must be in accordance with the coating manufacturer's recommendations, and as specified.

Application of coatings must be done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings carefully with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Surfaces must be sanded and dusted between coatings, as required, to produce a surface free of visible defects. High gloss coatings and clear finishes must be lightly sanded between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Do not accept cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections. Remove defective coating applications and recoat as directed.

Coating lines such as wainscots must be sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, must receive a dry-film thickness not less than specified.

3.3.2 Brush Application

Brushes must be clean and the proper size and type for high-quality application of the specified coating materials. Slow-dry coatings must be brushed out. Quick-dry coatings must be brushed only enough to spread out evenly.

3.3.3 Roller Application

Roller covers must be clean and of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.
Roller application must be done carefully and must be equivalent in all respects to the same coats applied by high-quality brush application.

3.3.4 Spray Application

Spray application equipment must be limited to airless-spray equipment and electrostatic-spray equipment. Equipment must be clean and operated by workmen skilled in high quality application of coating materials.

Spray application of coatings must be limited to finish coats on metal frame works, siding, decking, wire mesh, and other surfaces where hand work would be inferior. Sprayed coatings must be carefully applied and equivalent in all respects to the same coats applied by high quality brush application. Each spray coat must be permitted to cure before the succeeding coat is applied. Do not permit doubling back with application equipment, for the purpose of building up film thickness of two coats in one operation.

Surfaces adjacent to areas to be spray coated shall be covered to prevent damage from overspray, coating rebound, and spray drift.

3.4 ACCEPTANCE PROVISIONS

3.4.1 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

3.4.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Application equipment must be cleaned promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

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1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1152 (2006; R 2012) Methanol (Methyl Alcohol)
ASTM D1153 (2012) Methyl Isobutyl Ketone
ASTM D1200 (2010) Viscosity by Ford Viscosity Cup
ASTM D1210 (2005; R 2010) Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
ASTM D153 (1984; R 2008) Specific Gravity of Pigments
ASTM D2917 (2007) Methyl Isoamyl Ketone
ASTM D3721 (2005; R 2011) Synthetic Red Iron Oxide Pigment
ASTM D4417 (2011) Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D520 (2000; R 2011) Zinc Dust Pigment
ASTM D561 (1982; R 2008) Carbon Black Pigment for Paint

ASTM D740 (2011) Methyl Ethyl Ketone

ASTM D841 (2013) Nitration Grade Toluene


ASTM E1347 (2006; R 2011) Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)


ANSI/ISEA Z87.1 (2010) Occupational and Educational Personal Eye and Face Protection Devices

MASTER PAINTERS INSTITUTE (MPI)

MPI 212 (Oct 2009) Floor Coating, Thin Film, for Aircraft Maintenance Facilities

MPI 46 (Oct 2009) Interior Enamel Undercoat

MPI 50 (Oct 2009) Interior Latex Primer Sealer

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)


SSPC PS 26.00 (2000; E 2004) Aluminum Pigmented Epoxy Coating System Materials Specification, Performance-Based (Type I for use over Blast Cleaned Steel and Type II for use over Hand Cleaned Steel)

SSPC Paint 25 (1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

SSPC Paint 27 (1982; E 2004) Basic Zinc Chromate-Vinyl Butyral Wash Primer


SSPC SP 1 (1982; E 2004) Solvent Cleaning

SSPC SP 3 (2004; E 2004) Power Tool Cleaning

SSPC SP 5/NACE No. 1 (2007) White Metal Blast Cleaning

SSPC SP 7/NACE No. 4 (2007) Brush-Off Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441 (2009; Rev D) Paint, Epoxy-Polyamide, General Specification for

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595 (Rev C; Notice 1) Colors Used in Government Procurement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1910.134 Respiratory Protection

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### 1.3 SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS

Perform work in accordance with all applicable health, safety, and environmental requirements as well as EM 385-1-1. Submit matters of interpretation of these requirements to the Government Representative for resolution before starting work. If no clarifications are sought, then the submittal is not necessary. Where the regulations conflict, the most stringent requirements shall apply. This paragraph supplements the health, safety, and environmental requirements of EM 385-1-1.
1.3.1 Safety

Submit a Safety Plan in accordance with the requirements of Section 01 of EM 385-1-1, including, but not limited to, each of the topic areas listed in Appendix A therein and the specified requirements. Develop each topic in a concise manner to include management and operational aspects. Submit a Ventilation Assessment Plan complying with all applicable safety standards.

1.3.1.1 Abrasive Blasting

For abrasive blasting comply with the requirements in Section 06.H of EM 385-1-1. In addition to the requirements in Section 20 of EM 385-1-1, use hoses and hose connections of a type to prevent shock from static electricity. Hose lengths shall be joined together by approved couplings of a material and type designed to prevent erosion and weakening of the couplings. The couplings and nozzle attachments shall fit on the outside of the hose and designed to prevent accidental disengagement.

1.3.1.2 Workers Other Than Blasters

Protect workers, other than blasting operators working in close proximity to abrasive blasting operations, by utilizing MSHA/NIOSH-approved half-face or full-face air purifying respirators equipped with high-efficiency particulate air (HEPA) filters, eye protection meeting or exceeding ANSI/ISEA Z87.1 and hearing protectors (ear plugs and/or ear muffs) providing a noise reduction rating of at least 20 dBA or as needed to provide adequate protection. Personal protective equipment shall be provided where required by 29 CFR 1910.146 and in accordance with 29 CFR 1910, Subpart I.

1.3.1.3 Cleaning Before and After Abrasive Blasting

Cleaning with compressed air shall be in accordance with Section 20.B.5 of EM 385-1-1 and personnel shall be protected as specified in 29 CFR 1910.134. When cleaning with solvents, provide ventilation where required by 29 CFR 1910.146 or where the concentration of solvent vapors exceeds 10 percent of the Lower Explosive Limit (LEL). Ventilation shall be in accordance with 29 CFR 1910.94, paragraph (c)(5).

1.3.1.4 Pretreatment of Metals and Concrete with Acids

Personnel shall be protected in accordance with 29 CFR 1910, Subpart I. In addition to the requirements of Section 05 of EM 385-1-1, provide an eyewash in accordance with ANSI/ISEA Z358.1, paragraph (6).

1.3.1.5 Paint Mixing

Local exhaust ventilation shall be provided in the area where coatings are mixed. This ventilation system shall be capable of providing at least 100 linear fpm of capture velocity in the mixing zone. Exposure of skin and eyes shall be avoided by wearing appropriate chemically resistant gloves, apron, safety goggles, and face shields meeting or exceeding the requirements of ANSI/ISEA Z87.1. A combination unit, comprised of an eyewash and deluge shower, within close proximity to the mixing operation shall be provided in accordance with ANSI/ISEA Z358.1, paragraph (9). Individuals who have a history of, or develop a sensitivity to epoxy or polyurethane resin systems, shall not conduct work tasks or otherwise be exposed to such chemicals.
1.3.1.6 Confined Spaces

When using solvent-based paint in confined spaces, prepare a Confined Spaces Plan. Provide ventilation to exchange air in the space at a minimum rate of 5,000 cubic feet per minute per spray gun in operation. It may be necessary to install both a mechanical supply and exhaust ventilation system to effect adequate air changes within the confined space. Locate and affix all air-moving devices to an opening of the confined space in a manner assuring that the airflow is not restricted or short circuited and is supplied in the proper direction. Means of egress shall not be blocked. Continue ventilation after completion of painting and through the drying phase of the operation. If the ventilation system fails or the concentration of volatiles exceeds 10 percent of the LEL (except in the zone immediately adjacent to the spray nozzle), stop painting and evacuate spaces until adequate ventilation is provided. Provide an audible alarm that signals system failure as an integral part of the ventilation system. The effectiveness of the ventilation shall be checked by using ventilation smoke tubes and making frequent oxygen and combustible gas readings during painting operations. Exhaust ducts shall discharge clear of the working areas and away from possible sources of ignition. Submit detailed written standard operating procedures for confined spaces in accordance with 29 CFR 1910.146 and EM 385-1-1, Section 6I. The procedures shall include:

a. Certificates of calibration for all testing and monitoring equipment. The certificates of calibration shall include: type of equipment, model number, date of calibration, firm conducting calibration, and signature of individual certifying calibration.

b. Methods of inspection of personal protective equipment prior to use.

c. Work practices and other engineering controls designed to reduce airborne hazardous chemical exposures to a minimum.

d. Specification of the design and installation of ventilation systems which shall provide adequate oxygen content and provide for the dilution of paint solvent vapor, lead, and other toxic particulates within the confined space. In addition, include plans to evaluate the adequacy of air flow patterns.

1.3.1.7 Paint Spraying

Submit a comprehensive written Respiratory Protection Plan in accordance with 29 CFR 1910.134, 29 CFR 1926.62, and Section 05.E of EM 385-1-1. During all spray painting operations, spray painters shall use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations that are compatible with air-purifying respirator Assigned Protection Factor (APF). Persons with facial hair that interferes with the sealing surface of the facepiece to face seal or interferes with respirator valve function shall not be allowed to perform work requiring respiratory protection. Air-purifying chemical cartridge/canister half- or full-facepiece respirators that have a particulate prefilter and are suitable for the specific type(s) of gas/vapor and particulate contaminant(s) may be used for nonconfined space painting, mixing, and cleaning (using solvents). These respirators may be used provided the measured or anticipated concentration of the contaminant(s) in the breathing zone of the exposed worker does not exceed the APF for the
respirator and the gas/vapor has good warning properties or the respirator assembly is equipped with a NIOSH-approved end of service life indicator for the gas(es)/vapor anticipated or encountered. Where paint contains toxic elements that may become airborne during painting in nonconfined spaces, air-purifying half- and full-facepiece respirators or powered air-purifying respirators equipped with appropriate gas vapor cartridges, in combination with a high-efficiency filter, or an appropriate canister incorporating a high-efficiency filter, shall be used.

1.3.1.8 Explosion Proof Equipment

Electrical wiring, lights, and other equipment located in the paint spraying area shall be of the explosion proof type designed for operation in Class I, Division 1, Group D, hazardous locations as required by the NFPA 70. Electrical wiring, motors, and other equipment, outside of but within 20 feet of any spraying area, shall not spark and shall conform to the provisions for Class I, Division 2, Group D, hazardous locations. Electric motors used to drive exhaust fans shall not be placed inside spraying areas or ducts. Fan blades and portable air ducts shall be constructed of nonferrous materials. Motors and associated control equipment shall be properly maintained and grounded. The metallic parts of air-moving devices, spray guns, connecting tubing, and duct work shall be electrically bonded and the bonded assembly shall be grounded.

1.3.1.9 Further Precautions

a. Workers shall wear nonsparking safety shoes.

b. Place and ground solvent drums, taken into the spraying area, on nonferrous surfaces. Maintain metallic bonding between containers and drums when materials are being transferred.

c. Inspect insulation on all power and lighting cables to ensure that the insulation is in excellent working condition and is free of all cracks and worn spots. Cables shall be further inspected to ensure that no connections are within 50 feet of the operation, that lines are not overloaded, and that they are suspended with sufficient slack to prevent undue stress or chafing.

1.3.1.10 Ignition Sources

Ignition sources, to include lighted cigarettes, cigars, pipes, matches, or cigarette lighters shall be prohibited in area of solvent cleaning, paint storage, paint mixing, or paint application.

1.3.2 Health

Prepare and submit a Medical Surveillance Plan and a statement from the examining physician indicating the name of each employee evaluated and any limitations which will preclude the employee from performing the work required. The statement shall include the date of the medical evaluation, the physician's name, signature, and telephone number.

1.3.2.1 Air Monitoring

Prepare and submit an Air Monitoring Test Plan. Perform air sampling and testing as needed to assure that workers are not exposed to contaminants above the permissible exposure limit. In addition, provide the Government Representative with a copy of the Air Monitoring Test Report from the
laboratory within five working days of the sampling date, including records of air monitoring plans and tests performed. Reports shall be submitted as soon as information is available. Also provide results from direct-reading instrumentation on the same day the samples are collected. Prepare and submit an Airborne Sampling Plan detailing the NIOSH 2003-154, Factory Mutual, or Underwriters Laboratories approved equipment, equipment calibration procedures, sampling methods, sampling to be performed, and analytical procedures to be used based on the type of work to be performed and anticipated toxic contaminants to be generated. Include the name of the accredited laboratory, listed by the American Industrial Hygiene Association (AIHA), to be used to conduct the analysis of any collected air samples.

1.3.2.2 Medical Status

Prior to the start of work, and annually thereafter, submit a Medical Status Report including records of medical tests. Medically evaluate all Contractor employees working with or around paint systems, thinners, blast media, those required to wear respiratory protective equipment, and those who will be exposed to high noise levels for the particular type of exposure they may encounter. Maintain medical records as required by 29 CFR 1910.20. The evaluation shall include:

a. Audiometric testing and evaluation of employees who will work in a noise environment with a time weighted average greater than or equal to 90 dBA.

b. Vision screening (employees who use full-facepiece respirators shall not wear contact lenses).

c. Medical evaluation shall include, but shall not be limited to, the following:

(1) Medical history including, but not limited to, alcohol use, with emphasis on liver, kidney, and pulmonary systems, and sensitivity to chemicals to be used on the job.

(2) General physical examination with emphasis on liver, kidney, and pulmonary system.

(3) Determination of the employee's physical and psychological ability to wear respiratory protective equipment and to perform job-related tasks.

(4) Determination of baseline values of biological indices for later comparison to changes associated with exposure to paint systems and thinners or blast media, which include: liver function tests to include SGOT, SGPT, GGPT, alkaline phosphates, bilirubin, complete urinalysis, EKG (employees over age 40), blood urea nitrogen (bun), serum creatinine, pulmonary function test, FVC, and FEV, chest x-ray (if medically indicated), blood lead and ZPP (for individuals where it is known there will be an exposure to materials containing lead), other criteria that may be deemed necessary by the Contractor's physician, and Physician's statements for individual employees that medical status would permit specific task performance.

(5) For lead-based paint removal, the medical requirements of 29 CFR 1926.62 shall also be included. Prepare and submit a
Worker Protection Plan in accordance with the requirements of 29 CFR 1926.62, addressing all necessary aspects of worker protection and including activities emitting lead, means to achieve compliance, alternative technologies considered, air monitoring program, implementation schedule, work practice program, administrative controls, multi-Contractor site arrangements, and jobsite inspections.

1.3.2.3 Change in Medical Status

Any employee whose medical status has changed negatively due to work related chemical and/or physical agent exposure while working with or around paint systems and thinners, blast media, or other chemicals shall be evaluated by a physician, and obtain a physicians statement as described in paragraph "MEDICAL STATUS" prior to allowing the employee to return to those work tasks. Submit a Change in Medical Status Report detailing any negative changes in employee medical status and the results of the physicians reevaluation statement.

1.3.3 Environmental Protection

In addition to the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, prepare an Environmental Protection Plan incorporating the submittals for Water Quality Plan, Containment Plan, Waste Disposal Plan, Soil Quality Plan, TSP Monitoring Plan, PM-10 Monitoring Plan, and Visible Emissions Monitoring Plan. The submitted plan shall also address all aspects of establishing and demarcating regulated areas, ventilation/containment system performance verification, and reporting of accidental releases. Comply with the following environmental protection criteria.

1.3.3.1 Waste Classification, Handling, and Disposal

Prepare and submit a Waste Disposal Plan in accordance with the requirements of 40 CFR 261 and 40 CFR 262 including classification and handling. The Contractor is responsible for assuring the proper disposal of all hazardous and nonhazardous waste generated during the project. Waste generated from abrasive blasting, lead-containing paints with recyclable steel or iron abrasives shall be disposed of as a hazardous waste or shall be stabilized with proprietary pre-blast additives regardless of the results of 40 CFR 261 App II, Mtd 1311. Where stabilization is preferred, employ a proprietary blast additive, that has been blended with the blast media prior to use. Place hazardous waste in properly labeled, closed containers shielded adequately to prevent dispersion of the waste by wind or water. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken. Store nonhazardous waste in closed containers separate from hazardous waste storage areas. All hazardous waste shall be transported by a licensed transporter in accordance with 40 CFR 263 and 49 CFR 171, Subchapter C. All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation. In addition to the number of copies required by 40 CFR 262.22, one copy of each Waste Manifest shall be supplied to the Government Representative prior to transportation.

1.3.3.2 Containment

Prepare a Containment Plan for containing debris generated during paint removal operations, including drawings, load-bearing capacity
calculations, and wind load calculations. When the design is such that the spent abrasive is allowed to accumulate in quantities greater than 1,000 pounds, and/or impart a significant wind load on the structure, have the drawings approved by a registered structural engineer. The drawings and calculations shall be stamped with the engineer's seal. Also identify the type and placement of water booms, methods for anchoring the booms, and the procedures for removing debris. Contain debris generated during paint removal operations in accordance with the requirements of SSPC Guide 6. Where required, verify the containment air pressure by instrument.

1.3.3.3 Visible Emissions Monitoring

Prepare a Visible Emissions Monitoring Plan including the provisions for halting work and correcting the containment in the event unacceptable emissions are observed. General statements shall not be used; specific methods, procedures, and details are required. Measure the time of emissions in accordance with 40 CFR 60, App A, Mtd 22. Monitor visible emissions for not less than 15 minutes of every hour. Calculate visible emissions for each hour by extrapolation. In no case shall visible emissions extend greater than 150 feet in any direction horizontal from the containment. In no case shall visible emissions be observed in the area of any sensitive receptor. If such emissions occur the job shall be shut down immediately and corrective action taken. Notify the foreman whenever visible emissions exceed 40 seconds in a 1 hour period. The foreman shall be notified and the job shall be shut down and corrective action taken whenever visible emissions exceed 75 seconds in a 2 hour period. Total observed visible emissions from the containment shall not exceed 1 percent of the work day. Shutdown and corrective action shall be taken to prevent such an occurrence. Document each time that the work is halted due to a violation of the visible emissions criteria. Documentation shall include the cause for shutdown and the corrective action taken to resolve the problem.

1.3.3.4 PM-10 Monitoring

Prepare and submit a PM-10 Monitoring Plan for monitoring emissions of particulate matter 10 microns or less in size (PM-10). The plan shall comply with the requirements of EPA regulation 40 CFR 50.6 and this paragraph. The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur. The positioning of air monitoring equipment shall be in accordance with 40 CFR 58, App E, Subpart (8). In addition, a minimum of two PM-10 monitors shall be used at the project site, one down wind from the project and one in the area of greatest public access (e.g., playground, school yard, or homeowner's yard). When the project is in an area where there are critical receptors nearby, monitoring shall be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, monitoring shall be performed 4 of the first 8 days and on a regular basis thereafter for a sum total of 25 percent of the time surface preparation and debris cleanup are performed. Failure to meet air quality regulatory limits shall require air monitoring to be repeated immediately after corrective actions have been taken. Also conduct preproject PM-10 monitoring. The preproject PM-10 monitoring shall be conducted a minimum of 2 weeks prior to the beginning of the project. The monitoring shall continue for a minimum of 3 days to establish background levels. A PM-10 Test Report shall be submitted to the Government Representative within 48 hours and shall include:
a. Name and location of jobsite.

b. Date of monitoring.

c. Time of monitoring (i.e., time monitoring begins and ends each day).

d. Identification and serial number of monitoring units.

e. Drawing showing specific location of monitoring units.

f. Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.

g. Wind direction and velocity.

h. A flow chart verifying the rate of air flow across the filter throughout the sampling period.

i. Name and address of laboratory.

j. Laboratory test procedure.

k. Laboratory test results.

l. Signatures of field and laboratory technicians conducting the work.

1.3.3.5 TSP Monitoring

Prepare a TSP Monitoring Plan for monitoring emissions of Total Suspended Particulates (TSP). The plan shall comply with the requirements of EPA regulation 40 CFR 50.12 and this paragraph. The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur. The positioning of air monitoring equipment shall be in accordance with 40 CFR 58, App E, Subpart (8). In addition, use a minimum of two TSP monitors at the project site, one down wind from the project and one in the area of greatest public access (e.g. playground, school yard, or homeowner's yard). Conduct TSP-lead monitoring in accordance with 40 CFR 50, App B. When the project is in an area where there are critical receptors nearby, monitoring shall be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, monitoring shall be performed 4 of the first 8 days and on a regular basis thereafter for a sum total of 25 percent of the time surface preparation and debris cleanup are performed. Failure to meet air quality regulatory limits shall require air monitoring to be repeated immediately after corrective actions have been taken. Also conduct preproject TSP monitoring. The preproject TSP monitoring shall be conducted a minimum of 2 weeks prior to the beginning of the project. Continue the monitoring for a minimum of 3 days to establish background levels. Submit a TSP Test Report to the Government Representative within 48 hours including:

a. Name and location of jobsite.

b. Date of monitoring.

c. Time of monitoring (i.e., time monitoring begins and ends each day).

d. Identification and serial number of monitoring units.
e. Drawing showing specific location of monitoring units.

f. Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.

g. Wind direction and velocity.

h. A flow chart verifying the rate of air flow across the filter throughout the sampling period.

i. Name and address of laboratory.

j. Laboratory test procedure.

k. Laboratory test results.

l. Signatures of field and laboratory technicians conducting the work.

1.3.3.6 Water Quality

Prepare a Water Quality Plan for all job sites where lead-containing or other hazardous paint will be removed, including provisions for halting work if spills or emissions are observed entering into bodies of water or found in areas where storm water runoff could carry the debris into bodies of water or storm sewers. The plan shall also address cleanup and reporting procedures. Conduct operations in such a manner that lead-containing and other hazardous paint debris do not contaminate the water and so that NPDES permits in accordance with EPA regulation 40 CFR 122 are not required for the project. In the event that there are any releases of lead paint debris into the waterways, with reportable quantities of hazardous substances designated pursuant to Section 311 of the Clean Water Act, they shall be reported to the EPA in accordance with 40 CFR 117 and 40 CFR 355. Releases or spills that carry into waterways or storm sewers shall be thoroughly documented. The documentation shall include the time and location of the release, amount of material released, actions taken to clean up the debris, amount of debris recovered, and corrective action taken to avoid a reoccurrence. Releases shall also be reported to the Coast Guard and other state and local authorities as appropriate. If the release is equivalent to 10 pounds or more of lead-containing material in a 24-hour period, it is considered to be a reportable quantity under CERCLA. Comply with 40 CFR 302.

1.3.3.7 Soil Quality

Prepare a Soil Quality Plan for all job sites where lead-containing or other hazardous paint will be removed. The plan shall include provisions for halting the work should soil contamination occur, correcting the deficiencies responsible for the contamination, and provide procedures for removing and replacing contaminated soil. Establish and implement practices and procedures for preventing contamination of the soil from the removal of lead-containing or other hazardous paints. Unless otherwise directed by the Government Representative, soil shall be considered to have been contaminated by the Contractor's operation if an increase in the total lead content of 100 PPM or greater over background levels occurs. For purposes of computing the increase compute the mean background levels and the mean post-removal levels. The 100 PPM criteria is met if the difference between the means is less than 100 PPM plus the 95 percent confidence limit. Soil sampling and testing shall be conducted prior to the beginning of the project and after the project is completed. Interim
testing may also be performed in the event the Contractor or Government Representative wants to confirm that the containment system and work practices continue to provide satisfactory protection of the soil. Unless otherwise directed by the Government Representative, the following minimum test locations shall be selected for soil analysis. Two locations shall be selected beneath or immediately adjacent to the structure being prepared, and additional samples shall be taken within 100 feet in each direction of the project (i.e., N, S, E, W) in which soil is present. The number of soil sample locations shall be sufficient to adequately characterize the soil contaminant levels within and around the project area. Five composite samples shall be collected at each location. Each of the five samples shall be comprised of five individual plugs of soil combined in a single bag. The composite samples at each location shall be collected using the following procedure:

a. Place a 1-square foot template at each location.

b. Remove a sample of soil 3/4 inch in diameter and 1/2 inch in depth at the center of the template and at each of the four corners. Place the five soil plugs into a single bag. This represents one of the three samples to be removed at a given location.

c. Move the template 1 inch in any direction and repeat the process to collect the second sample. Place all plugs in a separate bag. Move the template 1 inch farther to collect the third sample.

d. Identify each sample bag with the date, specific location of the sample, name and signature of the sampling technician, and complete chain of custody records.

e. It is critical that the specific location of each sample be thoroughly measured and documented as the final project testing (and any interim testing) shall be sampled in the precise locations.

Three samples collected at each location shall be analyzed. One of the remaining two samples shall be maintained by the Contractor for the duration of the project and the other by the Government Representative in the event reanalysis is required. Lead-containing samples shall be analyzed in accordance with EPA testing guidance as published in 40 CFR 261, App III, by a laboratory listed by the American Industrial Hygiene Association (AIHA) as being proficient in conducting the test. Note that if it is determined that contamination of the soil has occurred as a result of the paint removal operations, TCLP testing will be employed to determine if the soil shall be handled and disposed of as a hazardous waste. The initial sampling of the soil for total lead content does not establish whether the soil would be considered hazardous by TCLP testing. As a result, at the Contractor's option, additional prework soil samples may be removed (minimum of 105 grams is required for a single test at each site) to conduct TCLP testing to establish whether the soil would be classified as hazardous prior to project startup. In the event that there is a release of lead paint debris onto the soil and if the release is 10 pounds or more of lead-containing material in a 24-hour period, it is considered to be a reportable quantity under CERCLA. Comply with 40 CFR 302. Thoroughly document the occurrence of any spills of lead debris into the soil. The documentation shall include the time and location of the release, amount of material released, actions taken to clean up the debris, amount of debris reclaimed, and corrective action taken to avoid a reoccurrence. The documentation shall be provided to the Government Representative and shall also include the Soil Quality Test
Report with results of the prework and post work soil quality tests.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
   Safety, Health and Environmental Requirements
   Safety Plan; G
   Respiratory Protection Plan; G

SD-03 Product Data
   Manufacturer's Product Data Sheet; G

SD-04 Samples
   Product Samples
   Special Paint Formulas
   Solvent and Thinners

SD-06 Test Reports
   PM-10 Test Report
   Inspection Reports

SD-07 Certificates
   SSPC QP 1 Certificate
   Coating Thickness Gage Qualification
   Qualified Paint Applicator

1.5 QUALIFICATIONS

Qualifications and experience shall comply with the following.

1.5.1 Certified Environmental, Health, and Safety Professionals

Provide a certificate for each Certified EHS Professional; submit qualifications and experience of qualified and competent persons employed to provide preconstruction and onsite environmental, safety, and health services. Obtain acceptance of this submission prior to the submission of other required environmental, safety, and health submittal items. Utilize a qualified and competent person as defined in Section 01 of EM 385-1-1 to develop the required safety and health submittal and to provide onsite safety and health services during the contract period. The person shall be a Certified Industrial Hygienist (CIH), an Industrial Hygienist (IH), or a Certified Safety Professional (CSP) with a minimum of 3 years of demonstrated experience in similar related work. The CIH, IH, or CSP may utilize other qualified and competent persons, as defined in EM 385-1-1, to conduct on-site safety and health activities as long as these persons have a minimum of 2 years of demonstrated experience in similar related work and are under the direct supervision of the CIH, IH, or CSP. For lead containing jobsites, the competent and qualified person
shall have successfully completed an EPA or state accredited lead-based paint abatement Supervisor course specific to the work to be performed and shall possess current and valid state and/or local government certification, as required.

1.5.2 Qualified Painting Contractor

Provide a certified SSPC QP 1 Painting Contractor. Submit a copy of the SSPC QP 1 Certificate.

1.5.3 Qualified Paint Applicator

Submit records of qualification tests and third party certification for each Qualified Paint Applicator. Prior to the initiation of any work all paint applicators shall be tested and certified as meeting the requirements of the qualified paint applicator. Certification shall be administered by the government approved independent third party Test Agency. Applicators failing the certification test shall not be permitted to apply any paint on the project.

1.5.4 Coating Thickness Gage Qualification

Submit Coating Thickness Gage Qualification documentation of manufacturer's certification for all coating thickness gages. Magnetic flux thickness gages as described in ASTM D7091 shall be used to make all coating thickness measurements on ferrous metal substrates. Eddy current thickness gages as described in ASTM D7091 shall be used to measure coating thickness on all nonferrous metal substrates. Gages shall have an accuracy of +/- 3 percent or better. Gages to be used on the job shall be certified by the manufacturer as meeting these requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

Process and package paints to ensure that within a period of one year from date of manufacture, they will not gel, liver, or thicken deleteriously, or form gas in the closed container. Paints, unless otherwise specified or permitted, shall be packaged in standard containers not larger than 5 gal, with removable friction or lug-type covers. Containers for vinyl-type paints shall be lined with a coating resistant to solvents in the formulations and capable of effectively isolating the paint from contact with the metal container. Each container of paint or separately packaged component thereof shall be labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name, and formula or specification number of the paint together with special labeling instructions, when specified. Paint shall be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather shall be stored in ventilated, heated shelters. All paints shall be stored under cover from the elements and in locations free from sparks and flames.

1.7 AMBIENT CONDITIONS

Paint shall be applied only to surfaces that are above the dew point temperature and that are completely free of moisture as determined by sight and touch. Paint shall not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, the temperature of the surfaces to be painted and of air in contact therewith shall be not less than 45 degrees F during paint application nor shall
paint be applied if the surfaces can be expected to drop to 32 degrees F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and applying artificial heat, provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint shall not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

PART 2  PRODUCTS

Product Samples of each batch of thinner, solvent, and paint shall be submitted to the Government for testing. Submit Manufacturer's Product Data Sheet for each type of paint used; for products that are specified to be applied in accordance with the manufacturer's recommendations, submit the paint manufacturer's product data sheet or other written instructions for those products. Submit samples of all special paint formula, Military, Master Painter Institute, and SSPC paints and samples of solvents or thinners used to reduce the viscosity of the paint. Allow at least 30 days for sampling and testing of samples of paints and thinners. Sampling may be at the jobsite or source of supply. Notify the Government Representative when the paint and thinner are available for sampling. Sampling of each batch will be witnessed by the Government Representative unless otherwise specified or directed. Submit a 1-quart sample of paint and thinner for each batch proposed for use. The sample shall be labeled to indicate formula or specification number and nomenclature, batch number, batch quantity, color, date made, and applicable project contract number. Testing will be performed by the Government.

2.1  SPECIAL PAINT FORMULAS

Special paints shall have the composition as indicated in the formulas listed herein. Where so specified, certain components of a paint formulation shall be packaged in separate containers for mixing on the job. If not specified or otherwise prescribed, the color shall be that naturally obtained from the required pigmentation.

2.2  PAINT FORMULATIONS

Special paint formulas shall comply with the following:

2.2.1  Formula V-102e

This formula is for Vinyl-Type Ready-Mixed Aluminum Impacted Immersion Coating, the ingredients are shown below.

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinyl Resin, Type 3</td>
<td>18.2</td>
</tr>
<tr>
<td>Aluminum Powder</td>
<td>8.3</td>
</tr>
<tr>
<td>Diisodecylic Phthalate</td>
<td>3.1</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>33.8</td>
</tr>
</tbody>
</table>
a. The paint shall be furnished with the aluminum pigment mixed into the vehicle.

b. The viscosity of the paint shall be between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods.

2.2.2 Formula V-106d

This formula is for Vinyl-Type Red Oxide (Light or Dark Color) Impacted Immersion Coating, the ingredients are shown below.

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinyl Resin, Type 3</td>
<td>5.50</td>
</tr>
<tr>
<td>Vinyl Resin, Type 4</td>
<td>11.20</td>
</tr>
<tr>
<td>Synthetic Iron Oxide (Red) (Light or Dark Color)</td>
<td>15.80</td>
</tr>
<tr>
<td>Diisodecyl Phthalate</td>
<td>2.90</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>31.00</td>
</tr>
<tr>
<td>Toluene</td>
<td>33.54</td>
</tr>
<tr>
<td>Propylene Oxide</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

a. The pigment shall be dispersed by means of pebble mills or other approved methods to produce a fineness of grind (ASTM D1210) of not less than 7 on the Hegman scale. Grinding in steel-lined or steel-ball mills will not be permitted. No grinding aids, antisettling agents, or any other materials, other than those listed in the formula, will be permitted. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods.

b. The viscosity of the paint shall be between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

c. Furnish the paint in two colors which are obtained by the alternative use of synthetic red iron oxide pigments of different shade. The dark paint shall reasonably approximate color 10076 of FED-STD-595, and light colored paint shall be readily distinguishable in the field from the dark. Furnish the two shades in the volume ratio designated by the purchaser.
2.2.3 Formula V-766e

This formula is for Vinyl-Type White (or Gray) Impacted Immersion Coating, the ingredients are shown below.

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinyl Resin, Type 3</td>
<td>5.6</td>
</tr>
<tr>
<td>Vinyl Resin, Type 4</td>
<td>11.6</td>
</tr>
<tr>
<td>Titanium Dioxide and (for Gray)</td>
<td>13.0</td>
</tr>
<tr>
<td>Carbon Black</td>
<td></td>
</tr>
<tr>
<td>Diisodecyl Phthalate</td>
<td>2.9</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>32.0</td>
</tr>
<tr>
<td>Toluene</td>
<td>34.7</td>
</tr>
<tr>
<td>Ortho-Phosphoric Acid</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

a. The dispersion of pigment shall be accomplished by means of pebble mills or other approved methods to produce a fineness of grind (ASTM D1210) of not less than 7 on the Hegman scale. Grinding in steel-lined or steel-ball mills will not be permitted. No grinding aids, antisettling agents, or any other materials except those shown in the formula will be permitted. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods. The ortho-phosphoric acid shall be measured accurately and diluted with at least four parts of ketone to one part of acid and it shall be slowly incorporated into the finished paint with constant and thorough agitation.

b. The viscosity of the paint shall be between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

c. The white and gray paints shall be furnished in the volume ratio designated by the purchaser. The gray paint shall contain no pigments other than those specified. Enough carbon black shall be included to produce a dry paint film having a reflectance of 20-24 (ASTM E1347). The resulting gray color shall approximate color 26231 of FED-STD-595.

2.2.4 Formula V-103C

This formula is for Vinyl-Type Black-Finish Impacted Immersion Coating, the ingredients are shown below.

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinyl Resin, Type 3</td>
<td>20.0</td>
</tr>
</tbody>
</table>
River Re-Introduction Into Maurepas Swamp

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Black</td>
<td>1.5</td>
</tr>
<tr>
<td>Diisodecyl Phthalate</td>
<td>3.4</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>36.0</td>
</tr>
<tr>
<td>Toluene</td>
<td>39.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

**a.** The carbon black shall be dispersed to a fineness of grind (ASTM D1210) of not less than 7 on the Hegman scale. A paste composed of carbon black milled into a Type 3 vinyl resin dissolved in an appropriate solvent may be used provided the finished product has the specification composition and grind. Material shall be free from seeding, gelling, and other deleterious effects. No grinding aids, antisetting agents, or any other materials except those shown in the formula will be permitted.

**b.** The viscosity of the paint shall be between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods.

2.2.5 Formula VZ-108d

This formula is for Vinyl-Type Zinc-Rich Impacted Immersion Coating, the ingredients are shown below.

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
<th>KILOGRAMS</th>
<th>POUNDS</th>
<th>LITERS</th>
<th>GALLONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPONENT A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vinyl Resin, Type 3</td>
<td>16.6</td>
<td>49.5</td>
<td>109.2</td>
<td>36.5</td>
<td>39.6</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>80.6</td>
<td>239.9</td>
<td>52.8</td>
<td>300.1</td>
<td>87.9</td>
</tr>
<tr>
<td>Suspending Agent E</td>
<td>0.7</td>
<td>2.1</td>
<td>4.6</td>
<td>1.0</td>
<td>0.28</td>
</tr>
<tr>
<td>Suspending Agent F</td>
<td>0.4</td>
<td>1.2</td>
<td>2.7</td>
<td>0.72</td>
<td>0.19</td>
</tr>
<tr>
<td>Methanol</td>
<td>0.5</td>
<td>1.5</td>
<td>3.3</td>
<td>1.89</td>
<td>0.50</td>
</tr>
<tr>
<td>Synthetic Iron Oxide (Red)</td>
<td>1.2</td>
<td>3.7</td>
<td>8.4</td>
<td>0.72</td>
<td>0.19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
<td><strong>297.8</strong></td>
<td><strong>65.6</strong></td>
<td><strong>341.1</strong></td>
<td><strong>109.0</strong></td>
</tr>
</tbody>
</table>

**COMPONENT B**

| Silane B                                   | 100.0             | 4.1       | 1.78   |

**COMPONENT C**

| Zinc Dust                                  | 100.0             | 550.0     | 35.7   |
a. The iron oxide and suspending agents shall be dispersed into the vehicle (Component A) to a fineness of grind of not less than 4 on the Hegman scale (ASTM D1210). Grinding in steel-lined containers or using steel-grinding media shall not be permitted. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods. The sole purpose of the iron oxide pigment is to produce a contrasting color. A red iron oxide-type 3 vinyl resin vehicle paste may be used in place of dry iron oxide provided compensating adjustment are made in the additions of Type 3 resin and methyl isobutyl ketone. The finished product with zinc dust added shall produce a paint which has a red tone upon drying and a reflectance of not more than 16 (ASTM E1347).

b. VZ-108d paint shall be supplied as a kit. Each kit shall consist of 4.5 gal (33.1 pounds) of Component A in a 5-gallon lug closure type pail, 27.5 pounds of zinc dust (Component C) packaged in a 1-gal plastic pail, and 3 fluid ounces of silane (Component B) packaged in a glass bottle of suitable size having a polyethylene lined cap. The bottle of silane shall be placed on the zinc dust in the 1-gal pail. In addition to standard labeling requirements, each container of each component shall be properly identified as to component type and each container label of Component A shall carry the following: MIXING AND APPLICATION INSTRUCTIONS: WARNING - THIS PAINT WILL NOT ADHERE TO STEEL SURFACES UNLESS COMPONENT B IS ADDED. Remove the 3 ounces of bottled Component B (silane) from the Component C (zinc dust) container and add to the base paint Component A) with thorough stirring. Then sift the zinc dust into the base paint while it is being vigorously agitated with a power-driven stirrer and continue the stirring until the zinc dust has been dispersed. The mixed paint shall at some point be strained through a 30-60 mesh screen to prevent zinc dust slugs from reaching the spray gun nozzle. The paint shall be stirred continuously during application at a rate that will prevent settling. If spraying is interrupted for longer than 15 minutes, the entire length of the hose shall be whipped vigorously to redisperse the zinc. If the spraying is to be interrupted for more than 1 hour, the hose shall be emptied by blowing the paint back into the paint pot. Thinning will not normally be required when ambient temperatures are below about 80 degrees F, but when the ambient and steel temperatures are higher, methyl isoamyl ketone (MIAK) or methyl isobutyl ketone (MIBK) should be used. If paint is kept covered at all times, its pot life will be about 8 days.

2.3 INGREDIENTS FOR SPECIAL PAINT FORMULAS

The following ingredient materials and thinners apply only to those special paints whose formulas are shown above in detail.

2.3.1 Pigments and Suspending Agents

2.3.1.1 Aluminum Powder

For vinyl paint aluminum powder shall conform to ASTM D962, Type 1, Class
2.3.1.2 Carbon Black

Carbon black shall conform to ASTM D561, Type I or II.

2.3.1.3 Zinc Dust

Zinc dust pigment shall conform to ASTM D520, Type II.

2.3.1.4 Iron Oxide

Iron oxide, (Dry) synthetic (red), shall conform to ASTM D3721. In addition, the pigment shall have a maximum oil absorption of 24 and a specific gravity of 4.90 to 5.20 when tested in accordance with ASTM D281 and ASTM D153, Method A, respectively. When the pigment is dispersed into specified vinyl paint formulation, the paint shall have color approximating FED-STD-595 color 10076 (dark red paint), and shall show no evidence of incompatibility or reaction between pigment and other components after 6 months storage.

2.3.1.5 Titanium Dioxide

Titanium dioxide in vinyl paint Formula V-766e shall be one of the following: Kronos 2160 or 2101, Kronos, Inc.; Ti-Pure R-960, E.I. DuPont DeNemours and Co., Inc.

2.3.1.6 Suspending Agent E

Suspending Agent E shall be a light cream colored finely divided powder having a specific gravity of 2 to 2.3. It shall be an organic derivative of magnesium aluminum silicate mineral capable of minimizing the tendency of zinc dust to settle hard without increasing the viscosity of the paint appreciably. M-P-A-14, produced by Elementis Specialties, has these properties.

2.3.1.7 Suspending Agent F

Suspending Agent F shall be a light cream colored finely divided powder having a specific gravity of approximately 1.8. It shall be an organic derivative of a special montmorillonite (trialkylaryl ammonium hectorite). Bentone 27, produced by Elementis Specialties, has these properties.

2.3.2 Resins, Plasticizer, and Catalyst

2.3.2.1 Plasticizer

The plasticizer shall be either Di 2-propyl Heptyl Phthalate (DPHP) or Diisodecyl Phthalate (DIDP). DPHP shall have an ester content of not less than 99.5 percent (ASTM D3465), shall contain not more than 0.1 percent water, and shall have an acid number (ASTM D1045) of not more than 0.07. DIDP shall have a purity of not less than 99.0 percent, shall contain not more than 0.1 percent water, and shall have an acid number (ASTM D1045) of not more than 0.10.

2.3.2.2 Vinyl Resin, Type 3

Vinyl resin, Type 3, shall be a vinyl chloride-acetate copolymer of medium
average molecular weight produced by a solution polymerization process and shall contain 85 +/- 1.0 percent vinyl chloride and 15 +/- 1.0 percent vinyl acetate by weight. The resin shall have film-forming properties and shall, in specified formulations, produce results equal to Vinnol H 15/50, as manufactured by Wacker Chemie AG.

2.3.2.3 Vinyl Resin, Type 4

Vinyl resin, Type 4, shall be a copolymer of the vinyl chloride-acetate type produced by a solution polymerization process, shall contain (by weight) 1 percent interpolymerized dicarbonic acid, 84 +/- 1.0 percent vinyl chloride, and 15 +/- 1.0 percent vinyl acetate. The resin shall have film-forming properties and shall, in the specified formulations, produce results equal to Vinnol H 15/45 M, as manufactured by Wacker Chemie AG.

2.3.2.4 Ortho-phosphoric Acid

Ortho-phosphoric acid shall be a chemically pure 85-percent grade.

2.3.3 Solvent and Thinners

2.3.3.1 Methanol

Methanol (methyl alcohol) shall conform to ASTM D1152.

2.3.3.2 Methyl Ethyl Ketone

Methyl ethyl ketone (MEK) shall conform to ASTM D740.

2.3.3.3 Methyl Isobutyl Ketone

Methyl isobutyl ketone (MIBK) shall conform to ASTM D1153.

2.3.3.4 Methyl Isoamyl Ketone

Methyl isoamyl ketone (MIAK) shall conform to ASTM D2917.

2.3.3.5 Toluene

Toluene shall conform to ASTM D841.

2.3.4 Silane B

Silane B for Formula VZ-108d shall be N-beta-(aminoethyl)-gamma-aminopropyltrimethoxy silane. Silquest A-1120, produced by Momentive Performance Materials Inc., and Silane Z-6020, produced by Dow Corning Corporation, are products of this type.

2.3.5 Propylene Oxide

Propylene oxide shall be a commercially pure product suitable for the intended use.

2.4 TESTING

2.4.1 Chromatographic Analysis

Solvents in vinyl paints and thinners shall be subject to analysis by
programmed temperature gas chromatographic methods and/or spectrophotometric methods, employing the same techniques that give reproducible results on prepared control samples known to meet the specifications. If the solvent being analyzed is of the type consisting primarily of a single chemical compound or a mixture of two or more such solvents, interpretation of the test results shall take cognizance of the degree of purity of the individual solvents as commercially produced for the paint industry.

2.4.2 Vinyl Paints

Vinyl paints shall be subject to the following adhesion test. When V-766 or V-106 formulations are tested, 5 to 7 mils (dry) shall be spray applied to mild steel panels. The steel panels shall be essentially free of oil or other contaminants that may interfere with coating adhesion. The test panels shall be dry blast cleaned to a White Metal grade which shall be in compliance with SSPC SP 5/NACE No. 1. The surface shall have an angular profile of 2.0 to 2.5 mils as measured by ASTM D4417, Method C. When V-102 or V-103 formulations are tested, they shall be spray applied over 1.5 to 2.5 mils (dry) of V-766 or V-106 known to pass this test. When VZ-108 is tested, the coating shall be mixed in its proper proportions and then spray applied to a dry film thickness of 1.5 to 2.5 mils above the blast profile. The VZ-108 shall be top coated with a V-766 known to pass this test. In all cases, the complete system shall have a total dry film thickness of 5 to 7 mils above the blast profile. After being air dried for 2 hours at room temperature, the panel shall be dried in a vertical position for 16 hours at 120 degrees F. After cooling for 1 hour, the panel shall be immersed in tap water at 85 to 90 degrees F for 48 to 72 hours. Immediately upon removal, the panel shall be dried with soft cloth and examined for adhesion as follows: With a pocket knife or other suitable instrument, two parallel cuts at least 1 inch long shall be made 1/4 to 3/8 inch apart through the paint film to the steel surface. A third cut shall be made perpendicular to and passing through the end of the first two. With the tip of the knife blade, the film shall be loosened from the panel from the third cut between the parallel cuts for a distance of 1/8 to 1/4 inch. With the panel being held horizontally, the free end of the paint film shall be grasped between the thumb and forefinger and pulled vertically in an attempt to remove the film as a strip from between the first two cuts. The strip of paint film shall be removed at a rate of approximately 1/10 inch per second and shall be maintained in a vertical position during the process of removal. The adhesion is acceptable if the strip of paint breaks when pulled or if the strip elongates a minimum of 10 percent during its removal. Paints not intended to be self-priming shall exhibit no delamination from the primer.

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

3.1.1 General Requirements

Clean surfaces to be painted before applying paint or surface treatments. Remove deposits of grease or oil in accordance with SSPC SP 1, prior to mechanical cleaning. Solvent cleaning shall be accomplished with mineral spirits or other low toxicity solvents having a flash point above 100 degrees F. Use clean cloths and clean fluids to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Protect items not to be prepared or coated from damage by the surface preparation methods. Machinery shall be protected against entry of blast abrasive and dust into
working parts. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces, and surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum; paint damaged by welding operations shall be restored to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed shall be painted before they become inaccessible.

3.1.2 Ferrous Surfaces Subject to Atmospheric Exposures

Ferrous surfaces that are to be continuously in exterior or interior atmospheric exposure and other surfaces as directed shall be cleaned by means of power tools or by dry blasting to the brush-off grade. Cleaning and priming shall be done in the shop unless otherwise directed or permitted. Power tool cleaning shall conform to the requirements of SSPC SP 3. Brush-off blast cleaning shall conform to the requirements of SSPC SP 7/NACE No.4. Welds and adjoining surfaces within a few inches (centimeters) thereof shall be cleaned of weld flux, spatter, and other harmful deposits by blasting, power impact tools, power wire brush, or such combination of these and other methods as may be necessary for complete removal of each type of deposit. The combination of cleaning methods need not include blasting when preparation of the overall surfaces is carried out by the power tool method. However, brush scrubbing and rinsing with clean water, after mechanical cleaning is completed, will be required unless the latter is carried out with thoroughness to remove all soluble alkaline deposits. Wetting of the surfaces during water-washing operations shall be limited to the weld area required to be treated, and such areas shall be dry before painting. Welds and adjacent surfaces cleaned thoroughly by blasting alone will be considered adequately prepared provided that weld spatter not dislodged by the blast stream shall be removed with impact or grinding tools. All surfaces shall be primed as soon as practicable after cleaning and in all cases prior to contamination or deterioration of the prepared surfaces. To the greatest degree possible, steel surfaces shall be cleaned (and primed) prior to lengthy outdoor storage.

3.1.2.1 Coated Ferrous Surfaces Subject to Atmospheric Exposures

Coated ferrous surfaces to be overcoated shall be power tool cleaned in accordance with SSPC SP 3. The entire surface to be overcoated does not have to be power tool cleaned provided that all surfaces are free of all loose rust and loose paint. Power tool prepared surfaces shall be further cleaned by power washing using a rotating tip and pressures of 1500 to 5000 PSI. Water pressure shall be adjusted such that all chalk is removed without significantly eroding the existing coating. After drying, all surfaces shall be spot primed as soon as practicable and in all cases prior to contamination or deterioration of the prepared surfaces.

3.1.3 Ferrous Surfaces Subject to Severe Exposure

Ferrous surfaces subject to extended periods of immersion or as otherwise required shall be dry blast-cleaned to SSPC SP 5/NACE No. 1. The blast profile, unless otherwise specified, shall be 1.5 to 2.5 mils as measured by ASTM D4417, Method C. Appropriate abrasive blast media shall be used to produce the desired surface profile and to give an angular anchor tooth
pattern. If recycled blast media is used, an appropriate particle size
distribution shall be maintained so that the specified profile is
consistently obtained. Steel shot or other abrasives that do not produce
an angular profile shall not be used. Weld spatter not dislodged by
blasting shall be removed with impact or grinding tools and the areas
reblasted prior to painting. Surfaces shall be dry at the time of
blasting. Blast cleaning to SSPC SP 5/NACE No. 1 shall be done in the
field and, unless otherwise specifically authorized, after final
eraction. Within 8 hours after blast cleaning, and in any case prior to
the deposition of any detectable moisture, contaminants, or corrosion, all
ferrous surfaces shall be cleaned of dust and abrasive particles by brush,
vacuum cleaner, and/or blown down with clean, dry, compressed air, and
given the first coat of paint. Upon written request by the Contractor,
the Government Representative may authorize mill or shop cleaning of
assembled or partially assembled components specified to receive one of
the vinyl-type paint systems or Systems 6-A-Z and 21-A-Z employing the
epoxy zinc-rich primer or Systems 23-A-Z and 23-B-Z employing SSPC Paint 40
moisture cure urethane zinc-rich primer. The surfaces, if shop blasted,
shall be shop coated with the first and second coats of the specified
paint system except that moisture cure urethane and epoxy zinc-rich primed
surfaces shall receive an extra single spray coat of the zinc primer at
the time field painting is started, as specified in the paint system
instructions. The shop coating shall be maintained in good condition by
cleaning and touching up of areas damaged during the construction period.
If pinpoint or general rusting appears, surfaces shall be reblasted and
repainted at no added cost to the Government. Prior to the field
application of subsequent coats, soiled areas of the shop coating shall be
thoroughly cleaned and all welds or other unpainted or damaged areas shall
be cleaned and coated in a manner to make them equivalent to adjacent,
undamaged paint surfaces.

3.1.4 Damp and Wet Ferrous Metal Surfaces

Ferrous surfaces that are wet with condensation or standing or running
water, shall be blast-cleaned to SSPC SP 5/NACE No. 1. The blast profile,
unless otherwise specified, shall be 1.5 to 3.0 mils as measured by
ASTM D4417, Method C. Appropriate abrasive blast media shall be used to
produce the desired surface profile and to give an angular anchor tooth
pattern. Steel grit or shot media shall not be used. Weld spatter not
dislodged by blasting shall be removed with impact or grinding tools and
the areas reblasted prior to painting. Surfaces shall be as dry as
possible at the time of blasting. Immediately after cleaning and prior to
the formation of extensive corrosion products, all ferrous surfaces blast
cleaned to SSPC SP 5/NACE No. 1 shall be cleaned of residual abrasive
particles, and given the first coat of paint. A slightly visible rust
bloom shall be permitted on surfaces to be painted.

3.1.5 Non-Ferrous Metal Surfaces

Non-ferrous metal surfaces to be painted shall be abrasive blasted to
rougthen the surface and promote adhesion. Before blast cleaning surfaces,
visible deposits of oil, grease, and other contaminants shall be removed
in accordance with SP 1. The entire surface shall be abrasive blasted so
as to produce a dense and uniform surface profile. The blasted surface
shall exhibit a continuous pattern with no smooth areas. Clean, dry
compressed air shall be used for abrasive blasting. Select an abrasive
size and type based on the surface to be cleaned. The abrasive shall be
dry and free of oil, grease, and other contaminants. Only non-metallic
abrasives shall be used. An abrasive shall be selected that minimizes
particle embedment in the surface. The blast cleaned metal surface shall have a minimum profile of 0.75 mils, when measured in accordance with ASTM D4417. Dust, dirt and loose residues shall be removed from blasted surfaces by brushing; blowing off with clean, dry air; or vacuuming. All surfaces shall be primed as soon as practicable after cleaning and in all cases prior to contamination or deterioration of the prepared surfaces.

3.1.6 Concrete Surfaces

New concrete surfaces, including concrete floors, shall be permitted to age for a minimum of 30 days prior to painting. Grease and oil removal shall be accomplished by solvent cleaning and/or detergent washing followed by rinsing. Loosely adherent materials such as dirt, dust, laitance, efflorescence, bleed water residues, or other foreign substances shall be removed by wire or fiber brushing, scrapers, light sandblasting, or other approved means. For interior walls and floors, sandblasting, unless otherwise specifically authorized, shall be restricted to the wet or vacuum type. Surface glaze, if present, shall be removed by light blasting or by scrubbing with a 5-percent solution of phosphoric acid. The texture of the surface after etching shall be roughly equivalent to the texture of an 80-120 grit sandpaper. If acid etching is used, the surface shall be thoroughly rinsed with clean water to remove all traces of the acid. Prior to painting, the concrete shall be dry. Adequate dryness shall be determined visually at the time of application by performing the following test. Tape 2-foot squares of polyethylene to the surface at random locations. The test patches shall remain in place overnight. Coatings shall only be applied if there are no traces of moisture and surfaces are dry beneath the polyethylene the following day.

3.1.7 Plaster Surfaces

At the time of painting, plaster surfaces shall be thoroughly dry and clean and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with approved patching materials, properly keyed to the existing surfaces, and sand-papered smooth. Plaster shall be permitted to age a minimum of 30 days before painting.

3.2 PAINT APPLICATION

3.2.1 General

The finished coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Application of initial or subsequent coatings shall not commence until the Government Representative has verified that atmospheric conditions and the surfaces to be coated are satisfactory. Each paint coat shall be applied in a manner that will produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint. Spray equipment shall be equipped with traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. Airless-type equipment shall not be used for the application of vinyl paints.
3.2.2 Mixing and Thinning

Paints shall be thoroughly mixed, strained where necessary, and kept at a uniform composition and consistency during application. Dry-powder pigments specified to be added at the time of use shall, with the aid of powered stirrers, be incorporated into the vehicle or base paint in a manner that will produce a smooth, homogeneous mixture free of lumps and dry particles. Where necessary to suit conditions of the surface temperature, weather, and method of application, the paint may be thinned immediately prior to use. Thinning shall generally be limited to the addition of not more than 1 pint per gal of the proper thinner; this general limitation shall not apply when more specific thinning instructions are provided. Paint that has been stored at low temperature, shall be brought up to at least 70 degrees F before being mixed and thinned, and its temperature in the spray tank or other working container shall not fall below 60 degrees F during the application. Paint that has deteriorated in any manner to a degree that it cannot be restored to essentially its original condition by customary field-mixing methods shall not be used and shall be removed from the project site. Paint and thinner that is more than 1 year old shall be resampled and resubmitted for testing to determine its suitability for application. Moisture cure urethane paint shall be resampled and resubmitted for testing to determine its suitability for application whenever the paint is more than six months old as indicated by the date of manufacture on the container.

3.2.3 Time Between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface.

3.2.4 Method of Paint Application

Unless otherwise specified, paint shall be applied by brush, roller, or spray to ferrous and nonferrous metal surfaces. Special attention shall be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces shall be subject to the specific approval of the Government Representative. Paint on plaster, concrete, or other nonmetallic surfaces shall be applied by brush, roller, and/or spray.

3.2.5 Coverage and Film Thickness

Film thickness or spreading rates shall be as specified hereinafter. Where no spreading rate is specified, the paint shall be applied at a rate consistent with the manufacturer's written instructions. In any event, the combined coats of a specified paint system shall completely hide base surface and the finish coats shall completely hide undercoats of dissimilar color.

3.2.5.1 Measurement on Ferrous Metal

Where dry film thickness requirements are specified for coatings on ferrous surfaces, measurements shall be made with a gage qualified in accordance with paragraph "Coating Thickness Gage Qualification". They shall be calibrated and used in accordance with ASTM D7091. Prior to each use the Base Metal Reading (BMR) shall be established for the gage as
specified in the test method. Accuracy of the gage shall be verified using plastic shims as specified by the test method both prior to and following each set of measurements. Frequency of measurements shall be as recommended for field measurements by ASTM D7091, except that measurements shall be performed on all areas of the structure being coated. Thickness measurements shall be reported as the mean for each spot determination.

3.2.5.2 Measurements on Nonferrous Metal

Where dry film thickness requirements are specified for coatings on nonferrous surfaces, measurements shall be made with a gage qualified in accordance with paragraph "Coating Thickness Gage Qualification". Gages shall be calibrated and used in accordance with ASTM D7091. Prior to each use the Base Metal Reading (BMR) shall be established for the gage as specified in the test method. Accuracy of the gage shall be verified using plastic shims as specified by the test method both prior to and following each set of measurements. Frequency of measurements shall be as recommended for field measurements by ASTM D7091, except that measurements shall be performed on all areas of the structure being coated. Thickness measurements shall be reported as the mean for each spot determination.

3.2.6 Progress of Painting Work

Where field painting on any type of surface has commenced, the complete painting operation, including priming and finishing coats, on that portion of the work shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating, and this period shall be modified as necessary to suit adverse weather conditions. Paint shall be considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces shall be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease, overspray, or foreign matter by means of airblast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, shall be brush-off blast cleaned and completely repainted as required. Undercoats of high gloss shall, if necessary for establishment of good adhesion, be scuff sanded, solvent wiped, or otherwise treated prior to application of a succeeding coat. Field coats on metal shall be applied after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.7 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted, but any resulting crevices shall subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections shall not be painted. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of the metal shall be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, shall not be painted.
3.2.8  Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion shall be: epoxy and moisture cure urethane systems at least 5 days, vinyl-type paint systems at least 3 days, and cold-applied coal tar systems at least 7 days. Minimum drying periods shall be increased twofold if the drying temperature is below 65 degrees F and/or if the immersion exposure involves considerable abrasion.

3.2.9  Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures shall be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. All metalwork coated in the shop or field prior to final erection shall be stored out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets; soiling, contamination, and deterioration of the paint film, and damaged areas of paint on such metalwork shall be cleaned and touched up without delay. The first field coat of paint shall be applied within a reasonable period of time after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.2.10  Vinyl Paints

3.2.10.1  General

Vinyl paints shall be spray applied, except that areas inaccessible to spraying shall be brushed. All of the vinyl paints require thinning for spray application except the zinc-rich vinyl paint (Formula VZ 108d) which will normally require thinning only under certain weather conditions. Thinners for vinyl paints shall be as follows:

<table>
<thead>
<tr>
<th>APPROXIMATE AMBIENT AIR TEMPERATURE (Degrees F)</th>
<th>THINNER</th>
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</thead>
<tbody>
<tr>
<td>Below 10 50</td>
<td>MEK</td>
</tr>
<tr>
<td>10 - 21 50 - 70</td>
<td>MIBK</td>
</tr>
<tr>
<td>Above 21 70</td>
<td>MIAK</td>
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</tbody>
</table>

The amount of thinner shall be varied to provide a wet spray and avoid deposition of particles that are semidry when they strike the surface. Vinyl paints shall not be applied when the temperature of the ambient air and receiving surfaces is less than 35 degrees F nor when the receiving surfaces are higher than 125 degrees F. Each spray coat of vinyl paint shall consist of a preliminary extra spray pass on edges, corners, interior angles, pits, seams, crevices, junctions of joining members, rivets, weld lines, and similar surface irregularities followed by an overall double spray coat. A double spray coat of vinyl-type paint shall consist of applying paint to a working area of not less than several hundred square feet (meters) in a single, half-lapped pass, followed after drying to at least a near tack-free condition by another spray pass applied at the same coverage rate and where practicable at right angles to
the first. Rivets, bolts, and similar surface projections shall receive sprayed paint from every direction to ensure complete coverage of all faces. Pits, cracks, and crevices shall be filled with paint insofar as practicable, but in any event, all pit surfaces shall be thoroughly covered and all cracks and crevices shall be sealed off against the entrance of moisture. Fluid and atomization pressures shall be kept as low as practicable consistent with good spraying results. Unless otherwise specified, not more than 2.0 mils, average dry film thickness, of vinyl paint shall be applied per double spray coat. Except where otherwise indicated, an undercoat of the vinyl-type paint may receive the next coat any time after the undercoat is tack-free and firm to the touch, provided that no speedup or delay in the recoating schedule shall cause film defects such as sags, runs, air bubbles, air craters, or poor intercoat adhesion. Neither the prime coat nor any other coat shall be walked upon or be subjected to any other abrading action until it has hardened sufficiently to resist mechanical damage.

3.2.10.2 Vinyl Zinc-Rich Primer

Primer shall be field mixed combining components A, B, and C. Mixing shall be in accordance with label instructions. After mixing, the paint shall be kept covered at all times to avoid contamination and shall be applied within 8 days after it is mixed. When the ambient and/or steel temperature is below about 80 degrees F, the paint will not normally require thinning; however, the paint shall at all times contain sufficient volatiles (thinner) to permit it to be satisfactorily atomized and to provide a wet spray and to avoid deposition of particles that are semidry when they reach the surface. The paint shall be stirred continuously during application at a rate that will prevent the zinc dust from settling. When spraying is resumed after any interruption of longer than 15 minutes, the entire length of the material hose shall be whipped vigorously until any settled zinc is redispersed. Long periods of permitting the paint to remain stagnant in the hose shall be avoided by emptying the hoses whenever the painting operation is to be suspended for more than 1 hour. The material (paint) hoses shall be kept as short as practicable, preferably not more than 50 feet in length. Equipment used for spraying this zinc primer shall not be used for spraying other vinyl-type paints without first being thoroughly cleaned, since many of the other paints will not tolerate zinc contamination; no type of hot spray shall be used. An average dry film thickness of up to 2.5 mils may be applied in one double-spray coat. Unless specifically authorized, not more than 8 days shall elapse after application of a VZ-108d zinc-rich coat before it receives a succeeding coat.

3.2.10.3 Vinyl Paints

Vinyl Paints (Formulas V-102e, V-103c, V-106d, and V-766e) are ready-mixed paints designed to be spray applied over a wide range of ambient temperatures by field thinning with the proper type and amount of thinner. For spray application, they shall be thinned as necessary up to approximately 25 percent (1 quart/gallon of base paint) with the appropriate thinner; when ambient and steel temperatures are above normal, up to 40-percent thinning may be necessary for satisfactory application.

3.2.11 Coal Tar-Epoxy (Black) Paint (Formula C-200a)

3.2.11.1 Mixing

Component B shall be added to previously stirred Component A and
thoroughly mixed together with a heavy-duty mechanical stirrer just prior to use. The use of not more than 1 pint of xylene thinner per 1 gal of paint will be permitted to improve application properties and extend pot life. The pot life of the mixed paint, extended by permissible thinning, may vary from 2 hours in very warm weather to 5 or more hours in cool weather. Pot life in warm weather may be extended by precooling the components prior to mixing; cooling the mixed material; and/or by slow, continuous stirring during the application period. The mixed material shall be applied before unreasonable increases in viscosity take place.

3.2.11.2 Application

Spray guns shall be of the conventional type equipped with a fluid tip of approximately 0.09 inch in diameter and external atomization, seven-hole air cap. Material shall be supplied to the spray gun from a bottom withdrawal pot or by means of a fluid pump; hose shall be 1/2 inch in diameter. Atomization air pressure shall not be less than 80 psi. High-pressure airless spray equipment may be used only on broad, simply configured surfaces. Brush application shall be with a stiff-bristled tool heavily laden with material and wielded in a manner to spread the coating smoothly and quickly without excessive brushing. The coverage rate of the material is approximately 110 square feet/gal per coat to obtain 20 mils (dry thickness) in a two-coat system. The paint shall flow together and provide a coherent, pinhole-free film. The direction of the spray passes (or finish strokes if brushed) of the second coat shall be at right angles to those of the first where practicable.

3.2.11.3 Subsequent Coats

Except at the high temperatures discussed later in this paragraph, the drying time between coal tar-epoxy coats shall not be more than 72 hours, and application of a subsequent coat as soon as the undercoat is reasonably firm is strongly encouraged. Where the temperature for substrate or coating surfaces during application or curing exceeds or can be expected to exceed 125 degrees F as the result of direct exposure to sunlight, the surfaces shall be shaded by overhead cover or the interval between coats shall be reduced as may be found necessary to avoid poor intercoat adhesion. Here, poor intercoat adhesion is defined as the inability of two or more dried coats of coal tar-epoxy paint to resist delamination when tested aggressively with a sharp knife. Under the most extreme conditions involving high ambient temperatures and sun-exposed surfaces, the drying time between coats shall not exceed 10 hours, and the reduction of this interval to a few hours or less is strongly encouraged. Where the curing time of a coal tar-epoxy undercoat exceeds 72 hours of curing at normal temperatures, 10 hours at extreme conditions, or where the undercoat develops a heavy blush, it shall be given one of the following treatments before the subsequent coat is applied:

a. Etch the coating surface lightly by brush-off blasting, using fine sand, low air pressure, and a nozzle-to-surface distance of approximately 3 feet.

b. Remove the blush and/or soften the surface of the coating by wiping it with cloths dampened with 1-methyl-2-pyrrolidone. The solvents may be applied to the surface by fog spraying followed by wiping, but any puddles of solvent shall be mopped up immediately after they form. Apply the subsequent coat in not less than 15 minutes or more than 3 hours after the solvent treatment.
3.2.11.4 Ambient Temperature

Coal tar-epoxy paint shall not be applied when the receiving surface or the ambient air is below 50 degrees F nor unless it can be reasonably anticipated that the average ambient temperature will be 50 degrees F or higher for the 5-day period subsequent to the application of any coat.

3.2.11.5 Safety

In addition to the safety provisions in paragraph "SAFETY, HEALTH, AND ENVIRONMENT", other workmen as well as painters shall avoid inhaling atomized particles of coal tar-epoxy paint and contact of the paint with the skin.

3.3 Paint Systems Application

The required paint systems and the surfaces to which they shall be applied are shown in this paragraph, and/or in the drawings. Supplementary information follows.

3.3.1 Fabricated and Assembled Items

Items that have been fabricated and/or assembled into essentially their final form and that are customarily cleaned and painted in accordance with the manufacturer's standard practice will be exempted from equivalent surface preparation and painting requirements described herein, provided that:

a. Surfaces primed (only) in accordance with such standard practices are compatible with specified field-applied finish coats.

b. Surfaces that have been primed and finish painted in accordance with the manufacturer's standard practice are of acceptable color and are capable of being satisfactorily touched up in the field.

c. Items expressly designated herein to be cleaned and painted in a specified manner are not coated in accordance with the manufacturer's standard practice if different from that specified herein.

3.3.2 Surface Preparation

The method of surface preparation and pretreatment shown in the tabulation of paint systems is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting shall be accomplished in accordance with detailed requirements previously described.

3.3.3 System No. 1

This epoxy paint system shall have been tested and passed all the test requirements of SSPC PS 26.00. Application shall be by spray, brush or roller in accordance with the manufacturer's written instructions. Dry film thickness per coat shall be within plus or minus 20 percent of that recommended by the manufacturer. Application of the system in less than two coats shall not be accepted. The epoxy coating shall be mixed and thinned in accordance with the manufacturer's written directions. Mixed coating material that has exceeded the manufacturers pot life shall not be applied. Materials that have been mixed for more than 8 hours or that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be
3.3.4 System No. 3

Paint shall be spray applied to an average dry film thickness of a minimum of 6.0 mils for the completed system and the thickness at any point shall not be less than 5.0 mils. Approximately 3.0 mils of the total dry film thickness shall be built up with Formula V-766e paint. The specified film thickness shall be attained in any event, and any additional coats needed to attain specified thickness shall be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided the heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass shall be applied at one time.

3.3.5 System No. 3-A-Z

Paint shall be spray applied to an average dry film thickness of a minimum of 6.5 mils for the completed system, and the thickness at any point shall not be less than 5.5 mils. The dry film thickness of the zinc-rich coat shall be approximately 2.5 mils. Specified film thickness, including the prescribed total, shall be attained in any event, and any extra coats needed to attain specified thickness shall be applied at no additional cost to the Government. Attaining of the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass of nonzinc paint shall be applied at one time.

3.3.6 System No. 4

Paint shall be spray applied to an average dry film thickness of a minimum of 7.5 mils for the completed system, and the thickness at any point shall not be less than 6.0 mils. The specified total film thickness shall be attained in any event, and additional coats needed to attain the specified thickness shall be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that no more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass of nonzinc paint shall be applied at one time.

3.3.7 System No. 5-A-Z

Paint shall be spray applied to an average dry film thickness of a minimum of 6.5 mils for the completed system and the thickness at any point shall not be less than 5.0 mils. The approximate dry film thickness after application of the first and second double spray coats shall be 2.5 and 4.0 mils, respectively. The specified film thickness shall be attained in any event, and any additional coats needed to attain specified thickness shall be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and
also provided that not more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass of nonzinc paint shall be applied at one time.

3.3.8 System No. 5-C-Z

Paint shall be spray applied to an average dry film thickness of a minimum of 7.0 mils for the completed system, and the thickness at any point shall not be less than 5.5 mils. The dry film thickness of the zinc-rich coat shall be approximately 2.5 mils. Specified film thickness, including the prescribed total, shall be attained in any event, and any extra coats needed to attain specified thickness shall be applied at no additional cost to the Government. Attaining of the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass of nonzinc paint shall be applied at one time.

3.3.9 System No. 5-D

Paint shall be spray applied to an average dry film thickness of a minimum of 7.5 mils for the completed system, and the thickness at any point shall not be less than 6.0 mils. The specified total film thickness shall be attained in any event, and any additional coats needed to attain specified thickness shall be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mils per single spray pass of nonzinc paint shall be applied at one time.

3.3.10 System No. 5-E-Z

Paint shall be spray applied to an average dry film thickness of a minimum of 7.0 mils for the completed system, and the thickness at any point shall not be less than 5.5 mils. The dry film thickness of the zinc-rich primer shall be approximately 2.5 mils. The specified film thickness shall be attained in any event, and any extra coats needed to attain the specified thickness shall be applied at no additional cost to the Government. Attaining the specified film thickness by applying fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass of nonzinc paint shall be applied at one time.

3.3.11 System No. 6

Paint shall be spray or brush applied with a minimum of two coats to provide a minimum total thickness at any point of 16 mils. The specified film thickness shall be attained in any event, and any additional (beyond two) coats needed to attain specified thickness shall be applied at no additional cost to the Government.
3.3.12 System No. 6-A-Z

Epoxy zinc-rich primer 19B shall be applied in accordance with the manufacturer's directions in two single, half-lapped spray coats to an average dry film thickness of a minimum of 3.0 mils. The thickness at any point shall not be less than 2.5 mils or greater than 8 mils for the primer. After a minimum drying period of 6 hours and no more than 96 hours, at least two coats of coal tar epoxy paint shall be applied to provide a minimum thickness at any point of 16 mils for the completed system. If the epoxy zinc-rich paint has been applied in the shop or otherwise has been permitted to cure for longer than 96 hours, it shall be abraded and recoated with an additional thin tack coat of the zinc-rich paint, which in turn shall be overcoated within 96 hours with the first coat of coal tar-epoxy paint. The specified film thicknesses shall be attained in any event, and any additional coats needed to attain specified thickness shall be applied at no additional cost to the Government.

3.3.13 System No. 7

A special primer shall be used under the coal tar-base paint only if/as recommended by the coating manufacturer. The materials shall be heavily applied by brush or with heavy-duty spray equipment at a coverage rate that will give a minimum total dry film thickness of 20 mils at any point for the completed system. The paint shall not be thinned unless recommended by the manufacturer. If brushed, the final strokes shall be at right angles to those of the preceding coat. Application and drying time between coats shall be as recommended by the coating manufacturer.

3.3.14 System No. 8

The coating shall be mixed and applied in accordance with the manufacturer's written instructions. The coating shall be applied in one or more coats to achieve an average dry film thickness of a minimum of 12 mils. Minimum thickness at any point shall be not less than 9 mils. Roller application is preferred. Application to vertical surfaces by airless spray may be performed provided all condensed water droplets are removed by wiping with a terry cloth towel immediately prior to spray application. Application to horizontal surfaces or surfaces otherwise covered by standing or running water shall be by roller. Brush application shall be limited to inside corners, bolt heads and other surface irregularities that are difficult to coat by roller. Subsequent coats shall be applied in the shortest recommended recoat interval. The minimum manufacturer recommended ambient and surface temperatures shall be maintained during application and curing of the coating.

3.3.15 System No. 10

Paint shall be applied according to manufacturers recommendations to a minimum average dry film thickness of 5 mils and the thickness at any point shall not be less than 4.0 mils. The specified film thickness may be obtained in a single coat provided this is allowed by manufacturers recommendations and provided this does not result in improper cure or result in the development of mud cracking or other film defects.

3.3.16 System No. 12

Galvanized surfaces shall be washed to expose damaged areas. Mars and breaks in the galvanized coating shall be hand or power tool cleaned to remove all corroded substrate. The damaged areas shall be touched up with
two coats of SSPC Paint 20, Type II.

3.3.17 System No. 17

Except as otherwise required, metal ductwork, conduit, pipe, radiators, grilles, louvers, pull boxes, and exposed surfaces of miscellaneous embedded metalwork shall be finish painted the same as adjacent ceilings or walls provided that:

a. The coat of MPI 50 may be omitted on metal surfaces primed with a shop or field coat of metal priming paint.

b. On bare ferrous surfaces the coat of MPI 50 shall be replaced with a coat of either SSPC Paint 25 or a coat of MPI 46.

c. Galvanized and other nonferrous metal surfaces shall be solvent cleaned in accordance with SSPC SP 1 and pretreated with SSPC Paint 27 in place of the MPI 50 coat.

3.3.18 System No. 18

Oil based alkyd paints shall be thinned using only odorless mineral spirits (ASTM D235). Except as otherwise required, metal ductwork, conduit, pipe, radiators, grilles, louvers, pull boxes, and exposed surfaces of miscellaneous embedded metalwork shall be finished the same as adjacent ceilings or walls provided that:

a. The coat of MPI 46 or MPI 50 may be omitted on metal surfaces primed with a shop or field coat of metal priming paint.

b. All bare ferrous surfaces shall be primed with either MPI 46 or SSPC Paint 25.

c. Galvanized and other nonferrous metal surfaces shall be cleaned in accordance with SSPC SP 1 and pretreated with SSPC Paint 27 in place of MPI 46 or MPI 50.

3.3.19 System No. 21

Paint shall be applied with a minimum of two single coats to produce an average dry film thickness totaling 6.0 mils. When applying MIL-DTL-24441, the type of thinner, amount of thinning, and required induction time shall be as recommended by the manufacturer. The drying time between coats shall not be less than 8 hours nor more than 96 hours.

3.3.20 System No. 21-A-Z

The epoxy zinc-rich paint 19B shall be applied in two singles half-lapped spray coats to an average dry film thickness of a minimum of 4.0 mils, and a thickness at any point of not less than 2.5 mils or greater than 8.0 mils. After a drying period of not less than 6 hours nor more than 96 hours, at least two coats of epoxy polyamide paint shall be applied to produce an average dry film thickness totaling 12 mils. If the epoxy zinc-rich paint has been applied in the shop or otherwise has been permitted to cure for longer than 96 hours, it shall be abraded and recoated with an additional thin tack coat of the zinc-rich paint, which in turn shall be overcoated within 96 hours with the first coat of the epoxy polyamide paint. When applying MIL-DTL-24441, the type of thinner, amount of thinning, and required induction time shall be as recommended by the manufacturer. The
drying time between non-zinc coats shall not be less than 12 hours nor more than 96 hours.

3.3.21 System No. 22

The floor coating system MPI 212 shall be applied according to the manufacturer's written instructions. It shall be a multi-coat system. The dry film thickness per coat shall be that recommended by the manufacturer.

3.3.22 System No. 23-A-Z

The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all requirements of the applicable SSPC standards. SSPC Paint 38 topcoat shall meet the requirements of Accelerated Weathering Level 3. Application shall be by spray in accordance with the manufacturer's written instructions. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.23 System No. 23-B-Z

The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standards. SSPC Paint 41 shall be modified with coal tar pitch. Application shall be by spray in accordance with the manufacturer's written instructions. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.24 System No. 23-C-Z

The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints
3.3.25 System No. 23-D

The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standards. Application shall be by spray, brush, or roller. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.26 System No. 23-E

The coating system shall be applied according to the manufacturer's written instructions. It shall be a two-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standard. Application shall be by spray, brush, or roller in accordance with the manufacturer's written instructions. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than two coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.27 Protection of Nonpainted Items and Cleanup

Walls, equipment, fixtures and all other items in the vicinity of the
surfaces being painted shall be maintained free from damage by paint or painting activities. Paint spillage and painting activity damage shall be promptly repaired.

3.4 INSPECTION

Inspect and document all work phases and operations on a daily basis. Submit daily Inspection Reports. As a minimum the daily report shall contain the following:

a. Inspections performed, including the area of the structure involved and the results of the inspection.

b. Surface preparation operations performed, including the area of the structure involved, the mode of preparation, the kinds of solvent, abrasive, or power tools employed, and whether contract requirements were met.

c. Thinning operations performed, including thinners used, batch numbers, and thinner/paint volume ratios.

d. Application operations performed, including the area of the structure involved, mode of application employed, ambient temperature, substrate temperature, dew point, relative humidity, type of paint with batch numbers, elapsed time between surface preparation and application, elapsed time for recoat, condition of underlying coat, number of coats applied, and if specified, measured dry film thickness or spreading rate of each new coating.

-- End of Section --
SECTION 09 97 02.01 12

PAINTING: COAL TAR EPOXY SYSTEM

10/08

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PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, appliances, materials, and performing all operations in connection with preparation of surfaces and application of paint and other specified materials. This work shall be accomplished in complete and strict accordance with the specifications.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)


ASTM INTERNATIONAL (ASTM)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70   (2011; Errata 2 2012) National Electrical Code

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 16 (2006) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

SSPC SP 1 (1982; E 2004) Solvent Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards
29 CFR 1910.134 Respiratory Protection
29 CFR 1910.146 Permit-required Confined Spaces
29 CFR 1910.20 Access to Employee Exposure and Medical Records
29 CFR 1910.94 Ventilation
29 CFR 1926 Safety and Health Regulations for Construction
29 CFR 1926.62 Lead
40 CFR 50.6 National Primary and Secondary Ambient Air Quality Standards for PM10
40 CFR 58 Ambient Air Quality Surveillance

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Safety and Health Provisions; G

An Accident Prevention Plan in accordance with the requirements of Section 01 of EM 385-1-1. The plan shall include, but is not limited to, each of the topic areas listed in Appendix A therein and the specified requirements; each topic shall be developed in a concise manner to include management and operational aspects.

Confined Spaces

Detailed written standard operating procedures for confined spaces in accordance with 29 CFR 1910.146 and EM 385-1-1, Section 34. The procedures shall include:
a. Certificates of calibration for all testing and monitoring equipment. The certificates of calibration shall include: type of equipment, model number, date of calibration, firm conducting calibration, and signature of individual certifying calibration.

b. Methods of inspection of personal protective equipment prior to use.

c. Work practices and other engineering controls designed to reduce airborne hazardous chemical exposures to a minimum.

d. Specification of the design and installation of ventilation systems which shall provide adequate oxygen content and provide for the dilution of paint solvent vapor, lead, and other toxic particulates within the confined space. In addition, the Contractor shall include plans to evaluate the adequacy of air flow patterns.

Respirators


Certified Laboratory

An Airborne Sampling Plan detailing the NIOSH 98-119, Factory Mutual, or Underwriters Laboratories approved equipment, equipment calibration procedures, sampling methods, sampling to be performed, and analytical procedures to be used based on the type of work to be performed and anticipated toxic contaminants to be generated. The Contractor shall include the name of the accredited laboratory, listed by the American Industrial Hygiene Association (AIHA), to be used to conduct the analysis of any collected air samples.

Ventilation

A plan to provide ventilation assessment.

PM-10 Monitoring

A plan for monitoring emissions of particulate matter 10 microns or less in size (PM-10). The plan shall comply with the requirements of EPA regulation 40 CFR 50.6 and paragraph "PM-10 Monitoring". The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur.

SD-06 Test Reports

PM-10 Monitoring

Reports of the PM-10 monitoring tests.

Certified Laboratory

Reports of airborne sampling tests.
Inspection

Records of inspections and operations performed. Submittals shall be made on a daily basis.

SD-07 Certificates

Qualifications

Certification for all job sites. Submittal of the qualifications and experience of any additional qualified and competent persons employed to provide on-site environmental, safety, and health shall also be provided. Acceptance of this submission must be obtained prior to the submission of other required environmental, safety, and health submittal items.

Coating Thickness Gage Qualification

Documentation of manufacturer's certification shall be submitted for all coating thickness gages.

1.5 QUALIFICATIONS

Qualifications and experience shall comply with the following.

1.5.1 Certified Professional

The Contractor shall utilize a qualified and competent person as defined in Section 01 of EM 385-1-1 to develop the required safety and health submittal and to provide on-site safety and health services during the contract period. The person shall be a Certified Industrial Hygienist (CIH), an Industrial Hygienist (IH), or a Certified Safety Professional (CSP) with a minimum of 3 years of demonstrated experience in similar related work. The Contractor shall certify that the Certified Industrial Hygienist (CIH) holds current and valid certification from the American Board of Industrial Hygiene (ABIH), that the IH is considered board eligible by written confirmation from the ABIH, or that the CSP holds current and valid certification from the American Board of Certified Safety Professionals. The CIH, IH, or CSP may utilize other qualified and competent persons, as defined in EM 385-1-1, to conduct on-site safety and health activities as long as these persons have a minimum of 2 years of demonstrated experience in similar related work and are under the direct supervision of the CIH, IH, or CSP. For lead containing jobsites, the competent and qualified person shall have successfully completed an EPA or state accredited lead-based paint abatement Supervisor course specific to the work to be performed and shall possess current and valid state and/or local government certification, as required.

1.5.2 Coating Thickness Gage Qualification

Documentation of certification shall be submitted for all coating thickness gages. Magnetic flux thickness gages as described in ASTM D7091 shall be used to make all coating thickness measurements on ferrous metal substrates. Gages shall have an accuracy of +/- 3 percent or better. Gages to be used on the job shall be certified by the manufacturer as meeting these requirements.
1.6 SAMPLING AND TESTING

The Contractor shall allow at least 30 days for sampling and testing. Sampling may be at the jobsite or source of supply. The Contractor shall notify the Government Representative when the paint and thinner are available for sampling. Sampling of each batch shall be witnessed by the Government Representative unless otherwise specified or directed. A 1-quart sample of paint and thinner shall be submitted for each batch proposed for use. The sample shall be labeled to indicate formula or specification number and nomenclature, batch number, batch quantity, color, date made, and applicable project contract number. Testing will be performed by the Government. Costs for retesting rejected material will be deducted from payments to the Contractor at the rate of $300.00 dollars for each sample retested.

1.7 SAFETY AND HEALTH PROVISIONS

Work shall be performed in accordance with the requirements of 29 CFR 1910, 29 CFR 1926, EM 385-1-1, and other references as listed herein. Matters of interpretation of the standards shall be submitted to the Government Representative for resolution before starting work. Where the regulations conflict, the most stringent requirements shall apply. Paragraph "SAFETY AND HEALTH PROVISIONS" supplements the requirements of EM 385-1-1, paragraph (1). In any conflict between Section 01 of EM 385-1-1 and this paragraph, the provisions herein shall govern.

1.7.1 Abrasive Blasting

The Contractor shall comply with the requirements in Section 06.H of EM 385-1-1.

1.7.1.1 Hoses And Nozzles

In addition to the requirements in Section 20 of EM 385-1-1, hoses and hose connections of a type to prevent shock from static electricity shall be used. Hose lengths shall be joined together by approved couplings of a material and type designed to prevent erosion and weakening of the couplings. The couplings and nozzle attachments shall fit on the outside of the hose and shall be designed to prevent accidental disengagement.

1.7.1.2 Workers Other Than Blasters

Workers other than blasting operators working in close proximity to abrasive blasting operations shall be protected by utilizing MSHA/NIOSH-approved half-face or full-face air purifying respirators equipped with high-efficiency particulate air (HEPA) filters, eye protection meeting or exceeding ASSE/SAFE Z87.1 and hearing protectors (ear plugs and/or ear muffs) providing a noise reduction rating of at least 20 dBA or as needed to provide adequate protection.

1.7.2 Cleaning with Compressed Air

Cleaning with compressed air shall be in accordance with Section 20.B.5 of EM 385-1-1 and personnel shall be protected as specified in 29 CFR 1910.134.
1.7.3 Cleaning with Solvents

1.7.3.1 Ventilation

Ventilation shall be provided where required by 29 CFR 1910.146 or where the concentration of solvent vapors exceeds 10 percent of the Lower Explosive Limit (LEL). Ventilation shall be in accordance with 29 CFR 1910.94, paragraph (c)(5).

1.7.3.2 Personal Protective Equipment

Personal protective equipment shall be provided where required by 29 CFR 1910.146 and in accordance with 29 CFR 1910, Subpart I.

1.7.4 Mixing Epoxy and Polyurethane Resin Formulations

1.7.4.1 Exhaust Ventilation

Local exhaust ventilation shall be provided in the area where the curing agent and resin are mixed. This ventilation system shall be capable of providing at least 100 linear fpm of capture velocity measured at the point where the curing agent and resin contact during mixing.

1.7.4.2 Personal Protective Equipment

Exposure of skin and eyes to epoxy resin components shall be avoided by wearing appropriate chemically resistant gloves, apron, safety goggles, and face shields meeting or exceeding the requirements of ASSE/SAFE Z87.1.

1.7.4.3 Medical Precautions

Individuals who have a history of sensitivity to epoxy or polyurethane resin systems shall be medically evaluated before any exposure can occur. Individuals who are medically evaluated as exhibiting a sensitivity to epoxy resins shall not conduct work tasks or otherwise be exposed to such chemicals. Individuals who develop a sensitivity shall be immediately removed from further exposure and medically evaluated.

1.7.4.4 Emergency Equipment

A combination unit, comprised of an eyewash and deluge shower, within close proximity to the epoxy or polyurethane resin mixing operation shall be provided in accordance with ANSI Z358.1, paragraph (9).

1.7.5 Paint Application

1.7.5.1 Ventilation

When using solvent-based paint in confined spaces, ventilation shall be provided to exchange air in the space at a minimum rate of 5,000 cubic feet per minute per spray gun in operation. It may be necessary to install both a mechanical supply and exhaust ventilation system to effect adequate air changes within the confined space. All air-moving devices shall be located and affixed to an opening of the confined space in a manner that assures that the airflow is not restricted or short circuited and is supplied in the proper direction. Means of egress shall not be blocked. Ventilation shall be continued after completion of painting and through the drying phase of the operation. If the ventilation system fails or the concentration of volatiles exceeds 10 percent of the LEL (except in the

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zone immediately adjacent to the spray nozzle), painting shall be stopped and spaces evacuated until such time that adequate ventilation is provided. An audible alarm that signals system failure shall be an integral part of the ventilation system. The effectiveness of the ventilation shall be checked by using ventilation smoke tubes and making frequent oxygen and combustible gas readings during painting operations. Exhaust ducts shall discharge clear of the working areas and away from possible sources of ignition.

1.7.5.2 Explosion Proof Equipment

Electrical wiring, lights, and other equipment located in the paint spraying area shall be of the explosion proof type designed for operation in Class I, Division 1, Group D, hazardous locations as required by the NFPA 70. Electrical wiring, motors, and other equipment, outside of but within 20 feet of any spraying area, shall not spark and shall conform to the provisions for Class I, Division 2, Group D, hazardous locations. Electric motors used to drive exhaust fans shall not be placed inside spraying areas or ducts. Fan blades and portable air ducts shall be constructed of nonferrous materials. Motors and associated control equipment shall be properly maintained and grounded. The metallic parts of air-moving devices, spray guns, connecting tubing, and duct work shall be electrically bonded and the bonded assembly shall be grounded.

1.7.5.3 Further Precautions

a. Workers shall wear nonsparking safety shoes.

b. Solvent drums taken into the spraying area shall be placed on nonferrous surfaces and shall be grounded. Metallic bonding shall be maintained between containers and drums when materials are being transferred.

c. Insulation on all power and lighting cables shall be inspected to ensure that the insulation is in excellent working condition and is free of all cracks and worn spots. Cables shall be further inspected to ensure that no connections are within 50 feet of the operation, that lines are not overloaded, and that they are suspended with sufficient slack to prevent undue stress or chafing.

1.7.5.4 Ignition Sources

Ignition sources, to include lighted cigarettes, cigars, pipes, matches, or cigarette lighters shall be prohibited in area of solvent cleaning, paint storage, paint mixing, or paint application.

1.7.6 Health Protection

1.7.6.1 Air Sampling

The Contractor shall perform air sampling and testing as needed to assure that workers are not exposed to contaminants above the permissible exposure limit. In addition, the Contractor shall provide the Government Representative with a copy of the test results from the certified laboratory within five working days of the sampling date and shall provide results from direct-reading instrumentation on the same day the samples are collected.
1.7.6.2 Respirators

During all spray painting operations, spray painters shall use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations that are compatible with air-purifying respirator Assigned Protection Factor (APF). Persons with facial hair that interferes with the sealing surface of the facepiece to faceseal or interferes with respirator valve function shall not be allowed to perform work requiring respiratory protection. Air-purifying chemical cartridge/canister half- or full-facepiece respirators that have a particulate prefilter and are suitable for the specific type(s) of gas/vapor and particulate contaminant(s) may be used for nonconfined space painting, mixing, and cleaning (using solvents). These respirators may be used provided the measured or anticipated concentration of the contaminant(s) in the breathing zone of the exposed worker does not exceed the APF for the respirator and the gas/vapor has good warning properties or the respirator assembly is equipped with a NIOSH-approved end of service life indicator for the gas(es)/vapor anticipated or encountered. Where paint contains toxic elements such as lead, cadmium, chromium, or other toxic particulates that may become airborne during painting in nonconfined spaces, air-purifying half- and full-facepiece respirators or powered air-purifying respirators equipped with appropriate gas vapor cartridges, in combination with a high-efficiency filter, or an appropriate canister incorporating a high-efficiency filter, shall be used.

1.7.6.3 Protective Clothing and Equipment

All workers shall wear safety shoes or boots, appropriate gloves to protect against the chemical to be encountered, and breathable, protective, full-body covering during spray-painting applications. Where necessary for emergencies, protective equipment such as life lines, body harnesses, or other means of personnel removal shall be used during confined-space work.

1.8 MEDICAL STATUS

Prior to the start of work and annually thereafter, all Contractor employees working with or around paint systems, thinners, blast media, those required to wear respiratory protective equipment, and those who will be exposed to high noise levels shall be medically evaluated for the particular type of exposure they may encounter. Medical records shall be maintained as required by 29 CFR 1910.20. The evaluation shall include:

a. Audiometric testing and evaluation of employees who will work in a noise environment with a time weighted average greater than or equal to 90 dBA.

b. Vision screening (employees who use full-facepiece respirators shall not wear contact lenses).

c. Medical evaluation shall include, but shall not be limited to, the following:

   (1) Medical history including, but not limited to, alcohol use, with emphasis on liver, kidney, and pulmonary systems, and sensitivity to chemicals to be used on the job.

   (2) General physical examination with emphasis on liver, kidney,
and pulmonary system.

3) Determination of the employee's physical and psychological ability to wear respiratory protective equipment and to perform job-related tasks.

4) Determination of baseline values of biological indices for later comparison to changes associated with exposure to paint systems and thinners or blast media, which include: liver function tests to include SGOT, SGPT, GGPT, alkaline phosphates, bilirubin, complete urinalysis, EKG (employees over age 40), blood urea nitrogen (bun), serum creatinine, pulmonary function test, FVC, and FEV, chest x-ray (if medically indicated), blood lead and ZPP (for individuals where it is known there will be an exposure to materials containing lead), other criteria that may be deemed necessary by the Contractor's physician, and Physician's statements for individual employees that medical status would permit specific task performance.

1.9 CHANGE IN MEDICAL STATUS

Any employee whose medical status has changed negatively due to work related chemical and/or physical agent exposure while working with or around paint systems and thinners, blast media, or other chemicals shall be evaluated by a physician, and the Contractor shall obtain a physicians statement as described in paragraph "MEDICAL STATUS" prior to allowing the employee to return to those work tasks. The Contractor shall notify the Government Representative in writing of any negative changes in employee medical status and the results of the physicians reevaluation statement.

1.10 ENVIRONMENTAL PROTECTION

In addition to the requirements of section 01 57 23.00 12 STORM WATER POLLUTION PREVENTION MEASURES the Contractor shall comply with the following environmental protection criteria.

1.10.1 Waste Classification, Handling, and Disposal

The Contractor shall be responsible for assuring the proper disposal of all hazardous and nonhazardous waste generated during the project. Nonhazardous waste shall be stored in closed containers separate from hazardous waste storage areas. All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation.

1.10.2 Air Quality Monitoring

1.10.2.1 PM-10 Monitoring

The Contractor shall perform PM-10 monitoring. The positioning of air monitoring equipment shall be in accordance with 40 CFR 58, App E, Subpart (8). In addition, a minimum of two PM-10 monitors shall be used at the project site, one down wind from the project and one in the area of greatest public access (e.g., playground, school yard, or homeowner's yard). When the project is in an area where there are critical receptors nearby, monitoring shall be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, monitoring shall be performed 4 of the first 8 days and on a regular basis thereafter for a sum total of 25 percent of the time surface preparation...
and debris cleanup are performed. Failure to meet air quality regulatory limits shall require air monitoring to be repeated immediately after corrective actions have been taken. The Contractor shall also conduct preproject PM-10 monitoring. The preproject PM-10 monitoring shall be conducted a minimum of 2 weeks prior to the beginning of the project. The monitoring shall continue for a minimum of 3 days to establish background levels. A report of the results shall be submitted to the Government Representative within 48 hours and shall include:

1. Name and location of jobsite.
2. Date of monitoring.
3. Time of monitoring (i.e., time monitoring begins and ends each day).
4. Identification and serial number of monitoring units.
5. Drawing showing specific location of monitoring units.
6. Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.
7. Wind direction and velocity.
8. A flow chart verifying the rate of air flow across the filter throughout the sampling period.
9. Name and address of laboratory.
10. Laboratory test procedure.
11. Laboratory test results.
12. Signatures of field and laboratory technicians conducting the work.

1.11 PAINT PACKAGING, DELIVERY, AND STORAGE

Paints shall be processed and packaged to ensure that within a period of one year from date of manufacture, they will not gel, liver, or thicken deleteriously, or form gas in the closed container. Paints, unless otherwise specified or permitted, shall be packaged in standard containers not larger than 5 gallons, with removable friction or lug-type covers. Each container of paint or separately packaged component thereof shall be labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name, and formula or specification number of the paint together with special labeling instructions, when specified. Paint shall be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather shall be stored in ventilated, heated shelters. All paints shall be stored under cover from the elements and in locations free from sparks and flames.

PART 2 PRODUCTS

2.1 SPECIAL PAINT FORMULAS

Special paints shall have the composition as indicated in the formulas
listed herein. Where so specified, certain components of a paint formulation shall be packaged in separate containers for mixing on the job. If not specified or otherwise prescribed, the color shall be that naturally obtained from the required pigmentation.

2.2 PAINT FORMULATIONS

Special paint formulas shall comply with the following:

2.2.1 Formula C-200a, Coal Tar-Epoxy (Black) Paint

The paint shall conform to SSPC Paint 16 manufactured with Type 1 pitch. In addition to standard labeling, container labels shall include the term, Corps of Engineers Formula C-200a.

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

3.1.1 General Requirements

Surfaces to be painted shall be cleaned before applying paint or surface treatments. Deposits of grease or oil shall be removed in accordance with SSPC SP 1, prior to mechanical cleaning. Solvent cleaning shall be accomplished with mineral spirits or other low toxicity solvents having a flash point above 100 degrees F. Clean cloths and clean fluids shall be used to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Items not to be prepared or coated shall be protected from damage by the surface preparation methods. Machinery shall be protected against entry of blast abrasive and dust into working parts. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces, and surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum; paint damaged by welding operations shall be restored to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed shall be painted before they become inaccessible.

3.2 PAINT APPLICATION

3.2.1 General

The finished coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Application of initial or subsequent coatings shall not commence until the Government Representative has verified that atmospheric conditions and the surfaces to be coated are satisfactory. Each paint coat shall be applied in a manner that will produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint. Spray equipment shall be equipped with traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used.
only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. Airless-type equipment shall not be used for the application of vinyl paints.

3.2.2 Mixing and Thinning

Paints shall be thoroughly mixed, strained where necessary, and kept at a uniform composition and consistency during application. Paste or dry-powder pigments specified to be added at the time of use shall, with the aid of powered stirrers, be incorporated into the vehicle or base paint in a manner that will produce a smooth, homogeneous mixture free of lumps and dry particles. Where necessary to suit conditions of the surface temperature, weather, and method of application, the paint may be thinned immediately prior to use. Thinning shall generally be limited to the addition of not more than 1 pint per gallon of the proper thinner; this general limitation shall not apply when more specific thinning instructions are provided. Paint that has been stored at low temperature, shall be brought up to at least 70 degrees F before being mixed and thinned, and its temperature in the spray tank or other working container shall not fall below 60 degrees F during the application. Paint that has deteriorated in any manner to a degree that it cannot be restored to essentially its original condition by customary field-mixing methods shall not be used and shall be removed from the project site. Paint and thinner that is more than 1 year old shall be resampled and resubmitted for testing to determine its suitability for application.

3.2.3 Atmospheric and Surface Conditions

Paint shall be applied only to surfaces that are above the dew point temperature and that are completely free of moisture as determined by sight and touch. Paint shall not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, the temperature of the surfaces to be painted and of air in contact therewith shall be not less than 45 degrees F during paint application nor shall paint be applied if the surfaces can be expected to drop to 32 degrees F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and applying artificial heat, provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint shall not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

3.2.4 Time Between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface.

3.2.5 Method of Paint Application

Unless otherwise specified, paint shall be applied by brush or spray to ferrous and nonferrous metal surfaces. Special attention shall be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces shall be subject to the specific approval of the Government Representative. Paint on plaster, concrete, or
other nonmetallic surfaces shall be applied by brush, roller, and/or spray.

3.2.6 Coverage and Film Thickness

Film thickness or spreading rates shall be as specified hereinafter. Where no spreading rate is specified, the paint shall be applied at a rate normal for the type of material being used. In any event, the combined coats of a specified paint system shall completely hide base surface and the finish coats shall completely hide undercoats of dissimilar color.

3.2.6.1 Measurement on Ferrous Metal

Where dry film thickness requirements are specified for coatings on ferrous surfaces, measurements shall be made with a gage qualified in accordance with paragraph "Coating Thickness Gage Qualification". They shall be calibrated and used in accordance with ASTM D7091. They shall be calibrated using plastic shims with metal practically identical in composition and surface preparation to that being coated, and of substantially the same thickness (except that for measurements on metal thicker than 1/4 inch, the instrument may be calibrated on metal with a minimum thickness of 1/4 inch). Frequency of measurements shall be as recommended for field measurements by ASTM D7091 and reported as the mean for each spot determination. The instruments shall be calibrated or calibration verified prior to, during, and after each use.

3.2.7 Progress of Painting Work

Where field painting on any type of surface has commenced, the complete painting operation, including priming and finishing coats, on that portion of the work shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating, and this period shall be modified as necessary to suit adverse weather conditions. Paint shall be considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces shall be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease, overspray, or foreign matter by means of airblast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, shall be brush-off blast cleaned and completely repainted as required. Undercoats of high gloss shall, if necessary for establishment of good adhesion, be scuff sanded, solvent wiped, or otherwise treated prior to application of a succeeding coat. Field coats on metal shall be applied after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.8 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted, but any resulting crevices shall subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections shall not be painted. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of
the metal shall be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, shall not be painted.

3.2.9 Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion shall be: epoxy systems at least 5 days, vinyl-type paint systems at least 3 days, and cold-applied coal tar systems at least 7 days. Minimum drying periods shall be increased twofold if the drying temperature is below 65 degrees F and/or if the immersion exposure involves considerable abrasion.

3.2.10 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures shall be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. All metalwork coated in the shop or field prior to final erection shall be stored out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets; soiling, contamination, and deterioration of the paint film, and damaged areas of paint on such metalwork shall be cleaned and touched up without delay. The first field coat of paint shall be applied within a reasonable period of time after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.2.11 Coal Tar-Epoxy (Black) Paint (Formula C-200a)

3.2.11.1 Mixing

Component B shall be added to previously stirred Component A and thoroughly mixed together with a heavy-duty mechanical stirrer just prior to use. The use of not more than 1 pint of xylene thinner per 1 gallon of paint will be permitted to improve application properties and extend pot life. The pot life of the mixed paint, extended by permissible thinning, may vary from 2 hours in very warm weather to 5 or more hours in cool weather. Pot life in warm weather may be extended by precooling the components prior to mixing; cooling the mixed material; and/or by slow, continuous stirring during the application period. The mixed material shall be applied before unreasonable increases in viscosity take place.

3.2.11.2 Application

Spray guns shall be of the conventional type equipped with a fluid tip of approximately 0.09 inch in diameter and external atomization, seven-hole air cap. Material shall be supplied to the spray gun from a bottom withdrawal pot or by means of a fluid pump; hose shall be 1/2 inch in diameter. Atomization air pressure shall not be less than 80 psi. High-pressure airless spray equipment may be used only on broad, simply configured surfaces. Brush application shall be with a stiff-bristled tool heavily laden with material and wielded in a manner to spread the coating smoothly and quickly without excessive brushing. The coverage rate of the material is approximately 110 square feet/gallon per coat to obtain 20 mils (dry thickness) in a two-coat system. The paint shall flow together and provide a coherent, pinhole-free film. The direction of the spray passes (or finish strokes if brushed) of the second coat shall be at right angles to those of the first where practicable.
3.2.11.3 Subsequent Coats

Except at the high temperatures discussed later in this paragraph, the drying time between coal tar-epoxy coats shall not be more than 72 hours, and application of a subsequent coat as soon as the undercoat is reasonably firm is strongly encouraged. Where the temperature for substrate or coating surfaces during application or curing exceeds or can be expected to exceed 125 degrees F as the result of direct exposure to sunlight, the surfaces shall be shaded by overhead cover or the interval between coats shall be reduced as may be found necessary to avoid poor intercoat adhesion. Here, poor intercoat adhesion is defined as the inability of two or more dried coats of coal tar-epoxy paint to resist delamination when tested aggressively with a sharp knife. Under the most extreme conditions involving high ambient temperatures and sun-exposed surfaces, the drying time between coats shall not exceed 10 hours, and the reduction of this interval to a few hours or less is strongly encouraged. Where the curing time of a coal tar-epoxy undercoat exceeds 72 hours of curing at normal temperatures, 10 hours at extreme conditions, or where the undercoat develops a heavy blush, it shall be given one of the following treatments before the subsequent coat is applied:

a. Etch the coating surface lightly by brush-off blasting, using fine sand, low air pressure, and a nozzle-to-surface distance of approximately 3 feet.

b. Remove the blush and/or soften the surface of the coating by wiping it with cloths dampened with 1-methyl-2-pyrrolidone. The solvents may be applied to the surface by fog spraying followed by wiping, but any puddles of solvent must be mopped up immediately after they form. The subsequent coat shall be applied in not less than 15 minutes or more than 3 hours after the solvent treatment.

3.2.11.4 Ambient Temperature

Coal tar-epoxy paint shall not be applied when the receiving surface or the ambient air is below 50 degrees F nor unless it can be reasonably anticipated that the average ambient temperature will be 50 degrees F or higher for the 5-day period subsequent to the application of any coat.

3.2.11.5 Safety

In addition to the safety provisions in paragraph "SAFETY AND HEALTH PROVISIONS", other workmen as well as painters shall avoid inhaling atomized particles of coal tar-epoxy paint and contact of the paint with the skin.

3.3 PAINT SYSTEMS APPLICATION

The required paint systems and the surfaces to which they shall be applied are shown in this paragraph, and/or in the drawings. Supplementary information follows.

3.3.1 Fabricated and Assembled Items

Items that have been fabricated and/or assembled into essentially their final form and that are customarily cleaned and painted in accordance with the manufacturer's standard practice will be exempted from equivalent surface preparation and painting requirements described herein, provided
that:

a. Surfaces primed (only) in accordance with such standard practices are compatible with specified field-applied finish coats.

b. Surfaces that have been primed and finish painted in accordance with the manufacturer's standard practice are of acceptable color and are capable of being satisfactorily touched up in the field.

c. Items expressly designated herein to be cleaned and painted in a specified manner are not coated in accordance with the manufacturer's standard practice if different from that specified herein.

3.3.2 Surface Preparation

The method of surface preparation and pretreatment shown in the tabulation of paint systems is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting shall be accomplished in accordance with detailed requirements previously described.

3.3.3 System No. 6

Paint shall be spray or brush applied with a minimum of two coats to provide a minimum total thickness at any point of 16 mils. The specified film thickness shall be attained in any event, and any additional (beyond two) coats needed to attain specified thickness shall be applied at no additional cost to the Government.

3.3.4 Protection of Nonpainted Items and Cleanup

Walls, equipment, fixtures and all other items in the vicinity of the surfaces being painted shall be maintained free from damage by paint or painting activities. Paint spillage and painting activity damage shall be promptly repaired.

3.4 INSPECTION

The Contractor shall inspect, document, and report all work phases and operations on a daily basis. As a minimum the daily report shall contain the following:

a. Inspections performed, including the area of the structure involved and the results of the inspection.

b. Surface preparation operations performed, including the area of the structure involved, the mode of preparation, the kinds of solvent, abrasive, or power tools employed, and whether contract requirements were met.

c. Thinning operations performed, including thinners used, batch numbers, and thinner/paint volume ratios.

d. Application operations performed, including the area of the structure involved, mode of application employed, ambient temperature, substrate temperature, dew point, relative humidity, type of paint with batch numbers, elapsed time between surface preparation and application, elapsed time for recoat, condition of underlying coat, number of coats applied, and if specified, measured dry film thickness or spreading rate of each new coating.
3.5 PAINTING SCHEDULES

SYSTEM NO. 6

Items or surfaces to be coated: Steel Sheet Piling, Steel H-piling, Steel Pipe Piling, and Steel Discharge Pipes. The top 8-inch length of sheet piling and H-piling and pipe piling shall not be painted. Beginning 8 inches down from the top of the pile, 10-foot length of sheet piling, H-piling and pipe piling shall be painted with Coal-Tar Epoxy, System No. 6. Coat steel discharge pipe both sides for the entire length of pipe installed.

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<td>Coal tar-epoxy C-200a (black)</td>
<td>Coal tar-epoxy C-200a (black) (if needed to attain required 20 mil thickness)</td>
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PART 1   GENERAL

1.1   GENERAL REQUIREMENTS

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Submit exterior signage schedule in electronic media with spreadsheet format. Spreadsheet shall include sign location, sign type, and message. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit two color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.1.1   Wind Load Requirements

Exterior signage shall be designed to withstand 100 mph windload. Submit design analysis and supporting calculations performed in support of specified signage.

1.1.2   Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45  (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

Performance Specifications and Methods of Test

AMERICAN WELDING SOCIETY (AWS)


AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel


ASTM INTERNATIONAL (ASTM)


ASTM A653 (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A924 (2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process


1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

SD-03 Product Data

Modular Exterior Signage System; G
Installation; G
Exterior Signage; G
Wind Load Requirements; G

1.5 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.6 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.
PART 2  PRODUCTS

2.1  MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.1.1  Free-Standing Base Mount Pylon/Monolith Type Signs

2.1.1.1  Framing

Interior framing shall consist of aluminum tube columns welded to companion plates. Perimeter framing shall consist of aluminum angle framing welded to the post and plate system as designed. Framing members shall be designed to permit access to electrical equipment. Mounting shall be provided as shown. Framing members of steel shall be finished with semi-gloss baked enamel or two-component acrylic polyurethane. Openings shall be sealed from moisture and made tamper-proof.

2.1.1.2  Exterior Sheeting Panels

Modular panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.090 inch thick aluminum. Top and end panels shall be removable and shall be secured by 3/16 inch socket head jack nuts. Finish for metal panels shall be semi-gloss baked enamel.

2.1.1.3  Mounting

Mounting shall be provided by securing to concrete foundation as shown.

2.1.1.4  Finishes

Base finish shall be semi-gloss baked enamel. Metal panel system finish shall be baked enamel or two-component acrylic polyurethane.

2.1.2  Panel And Post/Panel Type Signs

2.1.2.1  Posts

One-piece aluminum posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept panel framing system described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Caps shall be provided for each post.

2.1.2.2  Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components shall be designed to interlock with posts with concealed fasteners.

2.1.2.3  Panels

Modular message panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.080 inch aluminum.
2.1.2.4 Finishes
Post finish shall be semi-gloss baked enamel. Metal panel system finish shall be baked enamel.

2.1.2.5 Mounting
Permanent mounting shall be provided by embedding posts in concrete foundation as shown. Removable mounting shall be provided by an aluminum sleeve embedded in concrete as shown.

2.1.3 Changeable Letter Directories
2.1.3.1 Frame and Trim
Aluminum alloy finish.

2.1.3.2 Header Plates
Header plate shall consist of background metal matching frame and having raised letters attached through the back.

2.1.3.3 Door Glazing
Door glazing shall be clear safety or tempered glass minimum 1/4 inch thick.

2.1.3.4 Door Construction
Door frame shall be of same material and finish as surrounding frame. Corners shall be mitered and assembled with concealed fasteners. Hinges shall be standard with manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.1.3.5 Door Locks
Door locks shall be manufacturer's standard and shall be keyed alike.

2.1.3.6 Fabrication
Frames and trim shall be assembled with corners welded and mitered to hairline fit, with no exposed fasteners. Removable changeable directory panel shall consist of aluminum back with corkboard covering backgrooved 1/4 inch on centers to receive letters.

2.1.3.7 Finishes
Post finish shall be semi-gloss baked enamel. Metal panel system finish shall be baked enamel.

2.1.3.8 Mounting
Directories shall be mounted to supporting structures with concealed fasteners in accordance with manufacturer's instructions.

2.2 ILLUMINATION
Concealed lighting shall be provided within panel framing members. Lighting shall be controlled by a photocell device. Top lighting shall be
provided by T-12 slimline lamps, 120 277 volt, 60-hertz, single-phase, Type 1, or Type 2 ballast. Ballast shall be integrally mounted, high power factor and rated for use down to minus 20 degrees F ambient starting temperature. Ballast and wiring within the sign shall be in metal raceways. Electrical equipment shall be UL or FM listed and comply with NFPA 70. Illumination shall be evenly distributed. A switch on the interior of the sign shall be provided to turn off power in the sign. Switch shall be readily accessible when sign is open.

2.3 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.3.1 Graphics

Signage graphics shall conform to the following:

a. Plate aluminum letters, 1/4 inch thick shall be provided and fastened to the message panel with concealed fasteners. Letters shall project from face of panel.

2.3.2 Messages

See drawings for message content. Typeface: Helvetica medium. Type size as indicated.

2.4 METAL PLAQUES

Design and location of plaques shall be as shown.

2.4.1 Cast Metal Plaques

2.4.1.1 Fabrication

Cast metal plaques shall have the logo, emblem and artwork cast in the bas relief technique. Plaques shall be fabricated from prime aluminum.

2.4.1.2 Size

Plaque size shall be as shown.

2.4.1.3 Border

Border shall be as shown.

2.4.1.4 Mounting

Mounting shall be concealed.

2.4.1.5 Finish

Finishes shall consist of aluminum light colored sandblasted background. Letters shall be satin polished and entire plaque shall be sprayed with two coats of clear lacquer.

2.5 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26 or ASTM B108 for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall
2.6 ANODIC COATING

Anodized finish shall conform to AA DAF45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

2.7 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a semi-gloss baked enamel finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

2.8 STEEL PRODUCTS

Structural steel products shall conform to ASTM A36. Sheet and strip steel products shall conform to ASTM A1011. Welding for steel products shall conform to AWS D1.2/D1.2M.

2.9 CAST BRONZE

Components shall be fabricated with sharp corners, flat faces, and accurate profiles. Burrs and rough spots shall be removed and polished. Faces shall be finished to a uniform high luster. Cast bronze shall be in accordance with ASTM B62.

2.10 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E84 and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.11 GLASS

Glass shall be in accordance with ASTM C1036, Type I, Class 1, Quality q3 and ANSI Z97.1.

2.12 FIBER-REINFORCED POLYESTER (FRP) PANELS

Fiber-reinforced polyester (FRP) shall be in accordance with ASTM D3841, Type II, Grade 1, Class 124.

2.13 ACRYLIC SHEET

Acrylic sheet shall be in accordance with the flammability requirements of ASTM E84 and shall conform to ANSI Z97.1.

2.14 POLYCARBONATE SHEET

Polycarbonate sheet shall conform to SAE AMS3611.

2.15 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be

conform to AWS Cl.1M/C1.1.
non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.16   SHOP FABRICATION AND MANUFACTURE

2.16.1   Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A123 and ASTM A653, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A924. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.16.2   Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.16.3   Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

2.17   COLOR, FINISH, AND CONTRAST

Color shall be as indicated on the drawings. For buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3   EXECUTION

3.1   INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included. Circuits installed underground shall conform to the requirements of
Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. Steel conduits installed underground and illuminated signage mounted directly on buildings shall be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Government Representative or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

-- End of Section --
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SECTION 13 34 19

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01/08

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PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Structural Performance

Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and conditions indicated.

1.1.1.1 Engineering

Design metal building systems conforming to procedures described in MBMA MBSM.

1.1.1.2 Design Loads

Conform to the requirements of MBMA MBSM, ASCE 7-10, and the building code applicable to the project geographical location.

1.1.1.3 Live Loads

Include all vertical loads induced by the building occupancy indicated on the drawings, as well as loads induced by maintenance workers, materials and equipment for roof live loads.

1.1.1.4 Wind Loads

Include horizontal loads induced by a hurricane wind speed of 160 mph.

1.1.1.5 Collateral Loads

Include additional dead loads other than the weight of metal building system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings.

1.1.1.6 Auxiliary Loads

Include dynamic live loads, such as those generated by cranes and materials-handling equipment indicated on detail drawings.

1.1.1.7 Load Combinations

Design metal building systems to withstand the most critical effects of load factors and load combinations as required by MBMA MBSM, ASCE 7-10, and the building code applicable to the project location.

1.1.1.8 Deflection Limits

Engineer assemblies to withstand design loads with deflections no greater than the following:
a. Purlins and Rafters; vertical deflection of 1/240 of the span.
b. Girts; horizontal deflection of 1/240 of the span.
c. Metal Roof Panels; vertical deflection of 1/240 of the span.
d. Metal Wall Panels; horizontal deflection of 1/240 of the span.

Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E1592.

1.1.2 Thermal Movements

Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, over stressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss as follows:

Temperature Change (Range); 120 F, ambient; 180 F, material surfaces.

1.1.3 Thermal Performance

Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C1363 or ASTM C518.

1.1.3.1 Metal Roof Panel Assemblies

a. U-Factor: 0.098
b. R-Value: 11

1.1.3.2 Metal Wall Panel Assemblies

a. U-Factor: 0.098
b. R-Value: 11

1.1.4 Air Infiltration for Metal Roof Panels

Air leakage through assembly must not exceed 0.06 cfm/sq.ft. of roof area when tested according to ASTM E168 at negative test-pressure difference of 1.57 lb/sq.ft.

1.1.5 Air Infiltration for Metal Wall Panels

Air leakage through assembly of not more than 0.06 cfm/sq.ft. of wall area when tested according to ASTM E283 at static-air-pressure difference of 6.24 lbf/sq.ft.

1.1.6 Water Penetration for Metal Roof Panels

No water penetration when tested according to ASTM E1646 at test-pressure difference of 2.86 lbf/sq.ft.
1.1.7 Water Penetration for Metal Wall Panels

No water penetration when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq.ft. and not more than 12 lbf/sq. ft.

1.1.8 Wind-Uplift Resistance

Provide metal roof panel assemblies that comply with ASCE 7-10.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)


AA ASD1 (2009) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)


AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2004) Standard Definitions for Use in the Design of Steel Structures

AISI SG03-3 (2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10 (2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel


ASTM INTERNATIONAL (ASTM)

ASTM A1008 (2012) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened


ASTM A475 (2003e1; R 2009) Standard Specification for Zinc-Coated Steel Wire Strand

ASTM A500 (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes


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<td>(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process</td>
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<td>ASTM C273</td>
<td>(2007a) Shear Properties of Sandwich Core</td>
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Materials


ASTM D2244 (2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates


ASTM D3363 (2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test


ASTM D522 (1993a; R 2008) Mandrel Bend Test of
Attacked Organic Coatings


ASTM D714 (2002; R 2009) Evaluating Degree of Blistering of Paints

ASTM D822 (2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings


ASTM E136 (2012) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

ASTM E1592 (2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference


ASTM E283 (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E331 (2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference


ASTM F436 (2011) Hardened Steel Washers
1.4 DEFINITIONS

ASTM DEFONLINE applies to this definition paragraph.

a. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.

b. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).
c. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).

d. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).

e. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).

f. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

g. Terminology Standard: Refer to MBMA "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.5 SYSTEM DESCRIPTION

General: Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.

Provide metal building system of size and with spacing, slopes, and spans indicated.

1.5.1 Primary Frame Type


b. Rigid Modular: Solid-member, structural-framing system with interior columns.

1.5.2 Fixed End-Wall Framing

Provide manufacturer's standard fixed end wall, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.

1.5.3 Eave Height

Eave height must be 28 feet.

1.5.4 Bay Spacing

As determined by manufacturer.

1.5.5 Roof Slope

Roof slope must be manufacturer's standard for frame type required.
1.5.6 Roof System

Provide manufacturer's standard metal roof panels with insulation.

1.5.7 Exterior Wall System

Provide manufacturer's standard field-assembled, insulated metal wall panels complete with vapor barrier conforming to ASTM E96.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Manufacturer's data indicating percentage of recycle material of the following to verify sustainable acquisition compliance; G

Manufacturer's catalog data; G

SD-04 Samples

Coil Stock, 12 inches long by the actual panel width

Roof Panels, 12 inches long by actual panel width

Wall Panels, 12 inches long by actual panel width

Fasteners

Metal Closure Strips 10 inches long of each type

Insulation, approximately 8 by 11 inches

Vapor Barrier

Manufacturer's color charts and chips, 4 by 4 inches

SD-05 Design Data

Manufacturer's descriptive and technical literature; G

Manufacturer's building design analysis; G

SD-06 Test Reports

test reports
Coatings and base metals; G
Factory Color Finish Performance Requirements

SD-07 Certificates

System components
Coil Stock certification
Aluminized Steel Repair Paint
Galvanizing Repair Paint
Enamel Repair Paint
Qualification of Manufacturer; G
Qualification of Erector; G

SD-08 Manufacturer's Instructions
Installation of Roof and Wall panels
shipping, handling, and storage

SD-11 Closeout Submittals
Manufacturer's Warranty
Contractor's Warranty for Installation

1.7 QUALITY ASSURANCE

1.7.1 Pre-Erection Conference

After submittals are received and approved but before metal building system work, including associated work, is performed, the Government Representative will hold a pre-erection conference to review the following:

a. The detail drawings, specifications, and manufacturer's descriptive and technical literature.

b. Finalize construction schedule and verify availability of materials, erector's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to metal building system erection, including, but not limited to: qualification of manufacturer, qualification of erector, manufacturer's catalog data, building design analysis, written instructions and test reports.

d. Support conditions for compliance with requirements, including alignment between and erection of structural members.

e. Flashing, special roofing and siding details, roof and wall penetrations, openings, and condition of other construction that will affect metal building system, including coatings and base metals,
factory color finish performance requirements, system components, and certificates for coil stock.

f. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.

g. Temporary protection requirements for metal panel assembly during and after installation.

h. Samples of aluminized steel repair paint, galvanizing repair paint, and enamel repair paint.

1.7.1.1 Pre-Roofing and Siding Installation Conference

After structural framing system erection and approval but before roofing, siding, insulation and vapor barrier work, including associated work, is performed; the Government Representative will hold a pre-roofing and siding conference to review the following:

a. Examine purlins, sub-girts and formed shapes conditions for compliance with requirements, including flatness and attachment to structural members.

b. Review structural limitations of purlins, sub-girts and formed shapes during and after roofing and siding.

c. Review flashings, special roof and wall details, roof drainage, roof and wall penetrations, roof equipment curbs, and condition of other construction that will affect the metal building system.

d. Review temporary protection requirements for metal roof and wall panels' assembly during and after installation.

e. Review roof and wall observation and repair procedures after metal building system erection.

1.7.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products, erection of structural framing and installation of roof and wall panels in the geographical area where construction will take place.

1.7.3 Manufacturer's Qualifications

Metal building system manufacturer must have a minimum of five (5) years experience as a qualified manufacturer and a member of MBMA of metal building systems and accessory products.

Provide engineering services by an authorized currently licensed engineer in the State of Louisiana, having a minimum of four years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" (MBMA MBSM); ASCE 7-10, and ASTM E1592.

Provide certified engineering calculations using the products submitted for:

a. Roof and Wall Wind Loads with basic wind speed, exposure category,
co-efficient, importance factor, designate type of facility, negative pressures for each zone, methods and requirements of attachment.

b. Roof Dead and Live Loads
c. Collateral Loads
d. Foundation Loads
f. Seismic Loads

1.7.4 Qualification of Erection Contractor

An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and must be approved and certified by the metal building system manufacturer.

1.7.5 Single Source

Obtain primary and secondary components and structural framing members, each type of metal roof, wall and liner panel assemblies, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.7.6 Welding

Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.

1.7.7 Structural Steel

Comply with AISC 325, ANSI/AISC 341 for seismic impacted designs, ANSI/AISC 360, for design requirements and allowable stresses.

1.7.8 Cold-Formed Steel

Comply with AISC/AISI 121 and AISI SG03-3 for design requirements and allowable stresses.

1.7.9 Fire-Resistance Ratings

Where indicated, provide metal panels identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL Bld Mat Dir or from the listings of another qualified testing agency. Combustion Characteristics must conform to ASTM E136.

1.7.10 Surface-Burning Characteristics

Provide metal panels having insulation and vapor barrier material with the following surface-burning characteristics as determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

1.7.11 Fabrication

Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles with dimensional and structural requirements.

Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B209. Fabricate metal panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.

1.7.12 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.8 SHIPPING, HANDLING AND STORAGE

1.8.1 Delivery

Package and deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

Stack and store metal panels horizontally on platforms or pallets, covered
with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Store in a manner to prevent bending, warping, twisting, and surface damage. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage. Retain strippable protective covering on metal panel for entire period up to metal panel installation.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction to minimize ultraviolet exposure.

1.9 PROJECT CONDITIONS

1.9.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing panel system or building.

1.9.2 Field Measurements

1.9.2.1 Established Dimensions for Foundations

Comply with established dimensions on approved anchor-bolt plans, established foundation dimensions, and proceed with fabricating structural framing. Do not proceed without verifying field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.9.2.2 Established Dimensions for Metal Panels

Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.9.2.3 Verification Record

Verify locations of all framing and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.10 COORDINATION

Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

Coordinate installation of fire suppression system, equipment supports, piping and supports and accessories.

Coordinate installation of plumbing system.

Coordinate installation of HVAC system, equipment supports and ductwork and supports which are specified in Division 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
Coordinate installation of roof penetrations.

Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.11 WARRANTY

1.11.1 Building System Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal building system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials and/or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 48 hours after notification, unless additional time is approved by the Government Representative. Failure to perform repairs within 48 hours of notification will constitute grounds for having emergency repairs performed by others and will not void the warranty.

1.11.2 Roof System Weather-Tightness Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, lost of weather-tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Government Representative. Failure to perform temporary repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. Immediate follow-up and completion of permanent repairs must be performed within 2 days from date of notification.

1.11.3 Roof and Wall Panel Finish Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the
metal building system manufacturer.

Liability under this warranty is exclusively limited to replacing the defective coated materials.

Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 48 hours after notification, unless additional time is approved by the Government Representative. Failure to perform repairs within 48 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2   PRODUCTS

2.1   STRUCTURAL FRAMING MATERIALS

2.1.1   W-Shapes
ASTM A992; ASTM A572 or ASTM A529.

2.1.2   Channel, Angles, M-Shapes and S-Shapes
ASTM A36; ASTM A572 or ASTM A529.

2.1.3   Plate and Bar
ASTM A36, ASTM A572 or ASTM A529.

2.1.4   Steel Pipe
ASTM A36, ASTM A53, ASTM A572 or ASTM A529.

2.1.5   Cold-Formed and Hot Formed Hollow Structural Sections

2.1.6   Structural-Steel Sheet
Hot-rolled, ASTM A1011 or cold-rolled, ASTM A1008.

2.1.7   Metallic-Coated Steel Sheet
ASTM A653, ASTM A606.

2.1.8   Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating
Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755.
   a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, and ASTM A123.
   b. Coated Steel Sheet: ASTM A792, and ASTM A463.

2.1.9   Joist Girders
Refer to Section 05 21 23 STEEL JOIST GIRDER FRAMING
2.1.10 High-Strength Bolts, Nuts, and Washers

ASTM A325, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.


2.1.11 Non-High-Strength Bolts, Nuts, and Washers


2.1.12 Anchor Rods

ASTM A572.


2.1.13 Threaded Rods

ASTM A572.


2.1.14 Primer

SSPC-Paint 15, Type I, red oxide.

2.2 FABRICATION

2.2.1 General

Comply with MBMA MBSM - "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

2.3 STRUCTURAL FRAMING

2.3.1 General

Clean all framing members to remove loose rust and mill scale. Provide 1 shop coat of primer to an average dry film thickness of 1 mil according to SSPC SP 2. Balance of painting and coating procedures must conform to SSPC Paint 15 and SSPC Painting Manual.

2.3.2 Primary Framing

Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing indicated.
Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.

a. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.

b. Frame Configuration: Single gable.

c. Exterior Column Type: Tapered.

d. Rafter Type: Tapered.

2.3.3 Secondary Framing

Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.

Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

a. Purlins: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; minimum depth as required to comply with system performance requirements.

b. Girts: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange minimum depth as required to comply with system performance requirements.

c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.

d. Flange Bracing: Structural-steel angles or cold-formed structural tubing to stiffen primary frame flanges.

e. Sag Bracing: Structural-steel angles.

f. Base or Sill Angles: Zinc-coated (galvanized) steel sheet.

g. Purlin and Girt Clips: Steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.

h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet.

i. Framing for Openings: Channel shapes; fabricated cold-formed, structural-steel sheet or structural-steel shapes. Frame head and
jamb of door openings, and head, jamb, and sill of other openings.

j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

2.3.4 Bracing

Provide adjustable wind bracing as follows:

a. Rods: ASTM A572 or ASTM A529 threaded a minimum of 12 inches at each end.

b. Cable: ASTM A475, extra-high-strength grade, as required to comply with system performance.

c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.

d. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

e. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

f. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

g. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

2.4 PANEL MATERIALS

2.4.1 Aluminum Sheet

Roll-form aluminum roof or wall panels to the specified profile, with .050 inch thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:


b. Individual panels to have continuous length to cover the entire length of any roof slope or wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

1. Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated roof slope and wall area.

2.4.2 Foam-Insulation Core Wall Panel

Provide factory-formed aluminum roof and wall panel assembly fabricated from two sheets of metal with modified polyisocyanurate or polyurethane
foam insulation core foamed-in-place during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.

a. Closed-Cell Content: 90 percent when tested according to ASTM D6226, ASTM C1289.

b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622.

c. Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.

d. Shear Strength: 26 psi when tested according to ASTM C273.

2.4.3 Insulated Panel Construction

Shop fabricate or field assemble insulated panel construction with specified exterior and interior aluminum sheet in accordance with manufacturer's printed instructions.

Insulation to be glass-fiber-ASTM C991, slag-wool-fiber or rock-wool-fiber conforming to ASTM C553 and ASTM C612 of thickness and density as required for the geographical area where construction will take place. Glass-Fiber and Mineral-Wool-Fiber are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/), and are a component of sustainable acquisition compliance.

Insulation fasteners to be adhesively attached, plate welded to projecting spindle anchors; capable of holding insulation of thickness indicated, secured in position with self-locking washer and complying with the following requirements:

a. Plate: Perforated galvanized carbon-steel sheet 0.030 inch thick by 2 inches square.

b. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

c. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

d. Anchor adhesive to be a product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

2.4.4 Finish

All panels are to receive a factory-applied finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.
b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). This finish coat must be oven-cured.

d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash-coat must be oven-cured.

e. Color: The exterior finish chosen from the manufacturer's color charts and chips.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalking</td>
<td>ASTM D523</td>
</tr>
<tr>
<td>Color Change and Conformity</td>
<td>ASTM D2244</td>
</tr>
<tr>
<td>Weatherometer</td>
<td>ASTM G23</td>
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<tr>
<td>Humidity</td>
<td>ASTM D822</td>
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<td>Salt Spray</td>
<td>ASTM B117</td>
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<td>Chemical Pollution</td>
<td>ASTM D1308</td>
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<td>Gloss at 60 degrees</td>
<td>ASTM D523</td>
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<td>Pencil Hardness</td>
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<td>ASTM D2794</td>
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<td>ASTM D522</td>
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<tr>
<td>Abrasion</td>
<td>ASTM D968</td>
</tr>
<tr>
<td>Flame Spread</td>
<td>ASTM E84</td>
</tr>
</tbody>
</table>

2.4.5 Repair Of Finish Protection

Repair paint for color finish enameled metal panel must be compatible paint of the same formula and color as the specified finish furnished by the metal panel manufacturer, conforming to ASTM A780.

2.5 MISCELLANEOUS METAL FRAMING

2.5.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A653 unless other wise indicated.

2.5.2 Fasteners for Miscellaneous Metal Framing

Refer to the following paragraph "FASTENERS".

2.6 FASTENERS

2.6.1 General

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties
required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7-10 requirements.

2.6.2 Exposed Fasteners

Fasteners for metal panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.6.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.6.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.6.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A 653 or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.7 FRAMES AND MATERIALS FOR OPENINGS

2.7.1 Doors

Fire-Rated and Non-Fire-Rated Door Assemblies conforming with NFPA 80 and based on testing according to NFPA 252 unless otherwise indicated.

2.7.2 Windows

Aluminum Window Assemblies conforming to AAMA/WDMA/CSA 101/I.S.2/A440 unless otherwise indicated.

2.8 ACCESSORIES

2.8.1 General

All accessories to be compatible with the metal panels; sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.8.2 Roof and Wall Accessories and Specialties

Aluminum roof curbs, equipment supports, roof hatches, dropout-type heat and smoke vents, hatch-type heat and smoke vents, gravity and roof ridge
ventilators, wall louvers and other miscellaneous roof and wall equipment or penetrations conforming to AAMA, ASTM, and UL as specified in Division 07 unless otherwise indicated.

2.8.3 Insulation

Faced, Glass-Fiber Blanket Insulation: ASTM C665, Type I; Class A, membrane-faced surface with a flame spread of 25 or less, except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

2.8.3.1 Polyethylene Vapor Retarder

Install polyethylene vapor retarder membrane over entire surface. Use fully compatible polyethylene tape to seal the edges of the sheets to provide a vapor tight membrane. Lap sheets not less than 6 inch. Provide sufficient material to avoid inducing stresses in sheets due to stretching or binding. All tears or punctures visible in the finished surface, at anytime during the construction process, must be sealed with polyethylene tape.

2.8.3.2 Wall Liner

Securely fasten wall liner into place in accordance with the manufacturer's recommendation and in a neatly presented appearance.

2.8.4 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D 1667; extruded or molded to the configuration of the specified metal panel and in lengths supplied by the metal panel manufacturer.

2.8.5 Metal Closure Strips

Factory fabricated aluminum closure strips to be the same gauge, thickness, color, finish and profile of the specified roof or wall panel.

2.8.6 Joint Sealants

2.8.6.1 Sealants

Sealants are to be an approved gun type for use in hand or air-pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.8.6.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.
2.8.6.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C920, Type II. Color to match panel colors.

2.8.6.4 Tape Sealant

Pressure sensitive, 100% solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the metal panel manufacturer.

2.9 SHEET METAL FLASHING AND TRIM

2.9.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.10 FINISHES

2.10.1 General

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

2.10.2 Appearance of Finished Work

Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

Before erection proceeds examine with the erector present the concrete foundation dimensions, concrete and/or masonry bearing surfaces, anchor bolt size and placement, survey slab elevation, locations of bearing plates, and other embedment's to receive structural framing with the metal building manufacturer's templates and drawings before erecting any steel components for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine primary and secondary framing to verify that rafters, purlins, angles, channels, and other structural and metal panel support members and anchorages have been installed within alignment tolerances required by metal building manufacturer, UL, ASTM, ASCE 7-10 and as required by the building code for the geographical area where construction will take place.
Examine roughing-in for components and systems penetrating metal roof or wall panels to verify actual locations of penetrations relative to seam locations of metal panels before metal roof or wall panel installation.

Submit to the Government Representative a written report, endorsed by Erector, listing conditions detrimental to performance of the Work.

Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Provide temporary shoring, guys, braces, and other supports during erection to keep the structural framing secure, plumb, and in alignment against temporary construction loading or loads equal in intensity of the building design loads. Remove temporary support systems when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment and performance.

Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous support members or anchorage for the metal roof or wall panels, doors, windows, roof curbs, ventilators and louvers according to metal building manufacturer's written instructions.

3.3 ERECTION OF STRUCTURAL FRAMING

Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in accordance with MBMA MBSM - "Metal Building Systems Manual".

Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer and the Government Representative.

Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.

Clean and roughen concrete and masonry bearing surfaces prior to setting plates. Clean bottom surface of plates.

Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for changes or discrepancies in elevations.

Maintain erection tolerances of structural framing in accordance with ANSI/AISC 360.

3.4 METAL WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.
Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.5 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place in accordance with NRCA 0405 and MBMA MBSM.

Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.

Work must allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Field cutting metal roof panels by torch is not permitted.

Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; the side laps of standard exterior corrugated sheets must not be not less than 2-1/2 corrugations.

Do not permit storage, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.

3.6 METAL PANEL FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
3.7 FLASHING, TRIM AND CLOSURE INSTALLATION

a. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

b. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.8 DOOR AND FRAME INSTALLATION

Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each door frame with elastomeric sealant compatible with metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.9 WINDOW INSTALLATION

Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each window frame with elastomeric sealant compatible with for metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.10 ACCESSORY INSTALLATION

3.10.1 General

Install accessories with positive anchorage to building and weather-tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

3.10.2 Dissimilar Metals

Where dissimilar metals contact one another or corrosive substrates are present, protect against galvanic action by painting dissimilar metal surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each surface, or by other permanent separation techniques as recommended by the metal building manufacturer.

3.10.3 Gutters and Downspouts

Comply with performance requirements, manufacturer's written installation instructions, and install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA 1793 recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
3.10.4 Insulation

Comply with performance requirements and manufacturer's written installation instructions. Install insulation concurrently with metal panel installation, in thickness indicated to cover entire roof and wall area.

3.10.5 Roof and Wall Accessories and Specialties

Install roof and wall accessories and specialties complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports unless otherwise indicated.

3.11 CLEAN-UP AND PROTECTION

3.11.1 Structural Framing

Clean all exposed structural framing at completion of installation. Remove metal shavings, filings, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.2 Metal Panels

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove protective coverings/films, grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.3 Touch-Up Painting

After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories. Clean and touch-up paint with manufacturer's touch-up paint.

3.12 WASTE MANAGEMENT

Separate waste in accordance with the Waste Management Plan, placing copper materials, ferrous materials, and galvanized sheet metal in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

Collect and place scrap/waste debris in containers. Promptly dispose of scrap/waste debris. Do not allow scrap/waste debris to accumulate on-site; transport scrap/waste debris from government property and legally dispose of them.

3.13 WARRANTY

3.13.1 MANUFACTURER'S WARRANTY

Submit all manufacturers' signed warranties to Government Representative.
prior to final commissioning and acceptance.

3.13.2 CONTRACTOR'S WARRANTY for INSTALLATION

Submit contractor's warranty for installation to the Government Representative prior to final commissioning and acceptance.

3.13.3 CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM

FACILITY DESCRIPTION:________________________________________________________

BUILDING NUMBER:__________________________________________________________

CORPS OF ENGINEERS CONTRACT NUMBER:______________________________________

CONTRACTOR

CONTRACTOR:______________________________________________________________
ADDRESS:_______________________________________________________________

POINT OF CONTACT:________________________________________________________

TELEPHONE NUMBER:________________________________________________________

OWNER

OWNER:_____________________________________________________________________
ADDRESS:__________________________________________________________________

POINT OF CONTACT:________________________________________________________

TELEPHONE NUMBER:_______________________________________________________

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_______________________________________________________
ADDRESS:__________________________________________________________________

POINT OF CONTACT:________________________________________________________

TELEPHONE NUMBER:_______________________________________________________
CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR METAL BUILDING SYSTEM
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY [CONTRACTOR] FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:

FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM.

ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS AND/OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE MUST BE REPAIRED AS APPROVED BY THE GOVERNMENT REPRESENTATIVE.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY MUST BE REPAIRED AS APPROVED BY THE GOVERNMENT REPRESENTATIVE.

THIS WARRANTY COVERS THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON [DATE] AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President) (Date)
CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE CONTRACTOR HEREBY SUPPLEMENTS THIS WARRANTY WITH WRITTEN WARRANTIES FROM
THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH IS
SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR IS
ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS
AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED
WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER
PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE
CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE,
OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE
BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES
GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS,
FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE
LIKE.

5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER
WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, GUTTERS AND DOWNSPOUTS; OR
CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING
SIDING.

6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE
ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS
COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN
CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS TAKE
PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND
BUILDING SYSTEM DEFICIENCIES MUST BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT
OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR GOVERNMENT
REPRESENTATIVE. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, MUST BE
INITIATED IMMEDIATELY; A WRITTEN PLAN MUST BE SUBMITTED FOR APPROVAL TO
REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK
FOR PERMANENT REPAIRS OR REPLACEMENT MUST BE STARTED WITHIN 30 DAYS AFTER
RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE
CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED
CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(Exclusions from Coverage Continued)


POST A FRAMED COPY OF THIS WARRANTY IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --
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02/02

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PART 1 GENERAL

1.1 SCOPE

All the materials and labor necessary for the installation of the foundation instrumentation shall be provided by the Contractor. The foundation instrumentation shall be installed in the locations shown on the drawings. The details of the installation are shown on the drawings and described below. Access to each piezometer riser pipe shall be provided to the Government throughout the life of the contract. The Contractor shall ensure that all foundation instrumentation is correctly placed and installed.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM F593 (2002; R 2008; E 2012) Stainless Steel Bolts, Hex Cap Screws, and Studs

1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control of the foundation instrumentation installation operations to assure compliance with contract requirements and shall maintain records of his quality control for all construction operations including but not limited to the following:

1. Installation of the piezometers including locating, drilling, setting tips, backfilling and extending risers.
2. Testing of the permanent piezometers after completion of installation.
3. Determine the elevation of the top of the riser pipe and piezometers to the nearest 0.1 foot, NAVD88.
4. Testing scour indicator cables to insure cable electrical continuity.
5. Installation of the settlement reference bolts and culvert reference markers.

1.4.2 Reporting

The original and two copies of these records tests, as well as records of the corrective action taken, shall be furnished to the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Corrosion Resistant Steel (C.R.S.)

2.1.1.1 C.R.S. Pipe

Piezometer pipe and fittings shall conform to the requirements of ASTM A312, Type 304. Pipe outside diameter shall be 1.660 inch. Wall thickness shall be 0.14 inch.

2.1.1.2 Piezometer Tips

The tips of the piezometers, comprised of the well screen and bottom plate shall be fabricated from type 304 corrosion resistant steel to the dimensions and requirements shown on the drawings.

2.1.1.3 C.R.S. Bolts

The reference and anchor bolts shall be of the sizes indicated on the drawings and conform to the applicable requirements of ASTM F593, Type 304, and ASTM F594, Type 304.
2.1.1.4 C.R.S. Plate

The identification tags for the reference bolts and piezometers shall be of the sizes indicated on the drawings and conform to the requirements of ASTM A167, Type 304 or ASTM A240, Type 304.

2.1.2 Reference Markers

The culvert reference markers shall be fabricated to the sizes indicated and the materials shown on the drawings.

2.1.3 Scour Indicators

The Contractor shall furnish and install the cables, concrete blocks, conduit and junction box as shown on the drawings. The cables from gate monolith, C-1, to the concrete blocks shall be Belden 83322 two conductor cables #16AWG. Concrete blocks shall be constructed of 4000 psi concrete as specified in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE. The wire embedded in the concrete block shall be #4AWG THW insulated wire. Conduit and junction box shall be sized as shown on the drawings and shall meet the applicable requirements of the Sections in DIVISION 26 - ELECTRICAL.

2.1.4 Junction Box

The Contractor shall furnish the electrical junction box for the scour indicator wires as shown on the drawings. The junction box shall be Neenah Catalog No. R-7517-A2 as manufactured by the Neenah Foundry Company, P.O. Box 729, 2121 Brooks Ave., Neenah, Wisconsin 54956, or equal, furnished with neoprene gasket and C.R.S. cap screws as furnished by the manufacturer. The bottom of the box shall be cored and tapped for the three 1-1/2 inch diameter conduits.

2.1.5 Conduit

The Contractor shall furnish all the conduit and couplings that are necessary. The conduit shall conform to ASTM A53, Type E, Grade A. The conduit and fittings shall be hot dip galvanized after fabrication in accordance with ASTM A123.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Piezometers in Soil

The piezometers shall be furnished and installed by the Contractor. Details of the installation are shown on the drawings along with the locations and elevations. The piezometers shall be placed in 6 inch diameter holes drilled by a rotary drilling method or other approved method which will insure proper placement of the tip, riser pipe, gravel around the tip, and grout around the riser pipe. The Contractor shall use a centering device to center the piezometer in the hole. The use of a bentonitic type drilling fluid is prohibited. Drilling fluid additives similar and equal to "Rever" and "Fastbreak" may be used. A temporary well casing of either iron or steel, new or used may be used to support the sides of the hole during installation of the piezometer. The temporary casing shall have an inside diameter of at least 6 inches and shall have sufficient thickness to retain its shape and maintain a true
section throughout its depth and may be in sections of any convenient length. The temporary casing shall be such as to permit its removal without interfering with the fill or riser pipe. Subject to approval, the Contractor may set the temporary casing by any method that will not create a cavity around the outside of the casing at any point along its entire length. If the temporary casing should become distorted, its removal and the installation of new casing will be required at no additional cost to the Government. All the borings will be drilled to a depth 1 foot below the base of the piezometer tip. The appropriate filter shall be placed in the bottom two feet of the hole. The filter gradation is provided at the end of this section of the specifications. The piezometer tip and riser pipe will be placed on the gravel filter. Additional gravel will be placed and tamped to bring the gravel filter to the required depth shown on the drawings. All the piezometers will require an impervious seal of cement bentonite backfill and tamped clay above the filter gravel as shown on the drawing. After installation of any piezometer that is below the drawdown water table and after the drilling additive, if used, has broken down, the Contractor shall sound and clean each piezometer and shall develop it by pumping with a pitcher pump or suitable means until the discharge clears up or for a period not to exceed 1 hour. Additional pumps may be required. If the drawdown pumping fails to develop any permanent piezometer, it shall be removed and replaced or plugged with grout, all without additional cost to the Government. If a piezometer is removed and an attempt made to replace it but ultimately it must be abandoned, it shall be plugged by injecting into the piezometer hole a wet cement grout consisting of 1 bag (94.4 pounds) of cement to 5 gallons of water. It shall be injected at a maximum pressure of 10 psi. For the piezometers that are installed above the drawdown water table, only a falling head permeability test will be conducted for 1 hour. After the water table is allowed to rise, the piezometers will each be pumped as described above. The Contractor shall, at all times, conduct his operations in such a manner as to prevent damage to the piezometers.

3.1.2 Scour Indicators

The cables to the concrete blocks shall be continuous with no splices allowed. The soldered connections at the concrete block shall be waterproofed and insulated. Conduit and cable installation shall be in accordance with applicable requirements of the Sections in DIVISION 26-ELECTRICAL. After the cables are installed, all three (3) scour indicator circuits shall be verified for electrical continuity with a test light or ohm meter.

3.1.3 Cable Leads

All cable leads shall be properly labeled as described in paragraph "LABELING OF CABLES." The cable leads shall be accessible for data collection at all times.

3.1.4 Electrical Conduits

The conduits shall be installed by the Contractor at the locations shown on the drawings. The Contractor shall be responsible for the connections and the exact route the conduit takes from each scour indicator to the junction box. The Contractor shall pull the cables from the scour indicators to the junction box.
3.1.5 Junction Box

The junction box shall be installed by the Contractor at the location shown on the drawings. The installation shall consist of setting the box, connecting the conduit, and pulling the cable through the conduit, into the box. A loop of wire about 12 inches long shall be left in each cable.

3.1.6 Reference Bolts and Markers

Installation of the settlement reference bolts and culvert markers shall be as shown on the drawings. Upon installation and again upon completion of the structure, the Contractor shall determine elevations and longitudinal distances for each reference bolt and culvert marker. The results of these surveys shall be submitted to the Government's Representative.

3.2 LABELING OF CABLES

The Contractor shall identify each scour indicator Block circuit with the designation "S.I. Block #1," "S.I. Block #2" or "S.I. Block #3" respectively as shown on the drawings. This identification shall consist of two copper bands with the designation stamped or punched on them. One shall be three (3) inches from the end of the wire, the second shall be nine (9) inches from the end of the wire.

-- End of Section --
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PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)


AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (2008) Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)


ASSE 1013 (2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire
Protection Principle Backflow Preventers - (ANSI approved 2010)


ASSE 1019  (2011) Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type (ANSI Approved 2004)

ASSE 1020  (2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300  (2010; Addenda 2011) Hypochlorites

AWWA B301  (2010) Liquid Chlorine


AWWA C606  (2011) Grooved and Shouldered Joints

AWWA C651  (2005; Errata 2005) Standard for Disinfecting Water Mains

AWWA C652  (2011) Disinfection of Water-Storage Facilities

AWWA C700  (2009) Standard for Cold Water Meters - Displacement Type, Bronze Main Case


AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M  (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding


ASME INTERNATIONAL (ASME)


Fixtures and Hydraulic Requirements for Water Closets and Urinals


ASME A112.36.2M (1991; R 2012) Cleanouts

ASME A112.6.1M (1997; R 2012) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.6.3 (2001; R 2007) Standard for Floor and Trench Drains

ASME A112.6.4 (2003: R 2012) Roof, Deck and Balcony Drains

ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)


ASME B16.15 (2011; INT thru June 2011) Cast Copper Alloy Threaded Fittings Classes 125 and 250

ASME B16.18 (2012) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges


ASME B16.23 (2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV

ASME B16.24 (2011) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

ASME B16.29 (2012) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

ASME B16.3 (2011) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.34 (2013) Valves - Flanged, Threaded and Welding End


ASME B16.4 (2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASME B16.5 (2009) Pipe Flanges and Flanged Fittings:
ASME B31.1  

ASME B31.5  

ASME B40.100  
(2005; R 2010) Pressure Gauges and Gauge Attachments

ASME BPVC SEC IX  
(2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A105  
(2011a) Standard Specification for Carbon Steel Forgings for Piping Applications

ASTM A183  

ASTM A193  
(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A47  

ASTM A515  

ASTM A516  

ASTM A518  

ASTM A53  

ASTM A536  

ASTM A733  

ASTM A74  

ASTM A888  
River Re-Introduction Into Maurepas Swamp

Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications


Rubber Products in Automotive Applications


ASTM D2672  (1996a; R 2009) Joints for IPS PVC Pipe Using Solvent Cement


ASTM D2737  (2012a) Polyethylene (PE) Plastic Tubing

ASTM D2846  (2009be1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems


ASTM D2996  (2001; E 2007; R 2007) Filament-Wound
"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D3035  (2012; E 2012) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

ASTM D3138  (2004; R 2011) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components


ASTM F1760  (2001; R 2011) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content


Elastomeric Seals (Gaskets) for Joining Plastic Pipe


ASTM F877 (2011a) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems


CAST IRON SOIL PIPE INSTITUTE (CISPI)


COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (1994; R 1995) Copper Tube Handbook

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117 (2005b) Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings 4 Install On CU Tubing

INTERNATIONAL CODE COUNCIL (ICC)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends


MSS SP-44 (2010; Errata 2011) Steel Pipeline Flanges

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<td>2011</td>
<td>Butterfly Valves</td>
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<td>MSS SP-69</td>
<td>2003</td>
<td>Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)</td>
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<td>MSS SP-70</td>
<td>2011</td>
<td>Gray Iron Gate Valves, Flanged and Threaded Ends</td>
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<td>MSS SP-72</td>
<td>2010a</td>
<td>Ball Valves with Flanged or Butt-Welding Ends for General Service</td>
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<td>MSS SP-73</td>
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<td>MSS SP-78</td>
<td>2011</td>
<td>Cast Iron Plug Valves, Flanged and Threaded Ends</td>
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<td>MSS SP-80</td>
<td>2008, Errata 2012</td>
<td>Bronze Gate, Globe, Angle and Check Valves</td>
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<td>MSS SP-83</td>
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<td>Class 3000 Steel Pipe Unions Socket Welding and Threaded</td>
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<td>MSS SP-85</td>
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<td>Gray Iron Globe &amp; Angle Valves Flanged and Threaded Ends</td>
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**NACE INTERNATIONAL (NACE)**

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<td>Control of External Corrosion on Underground or Submerged Metallic Piping Systems</td>
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**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

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**NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

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<td>Standard for the Installation of Air Conditioning and Ventilating Systems</td>
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<td>2012</td>
<td>Plastics Piping System Components and Related Materials</td>
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<tr>
<td>NSF/ANSI 61</td>
<td>2012, Errata 1013</td>
<td>Drinking Water System Components - Health Effects</td>
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**PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)**

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<td>PPFA-01</td>
<td>2004</td>
<td>Firestopping: Plastic Pipe in Fire</td>
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Resistive Construction

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223 (2004) Enzyme Substrate Coliform Test
PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 50.12 National Primary and Secondary Ambient Air Quality Standards for Lead

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures; G

List of installed fixtures with manufacturer, model, and flow rate.

Flush valve water closets
Flush valve urinals

Service sinks
Backflow prevention assemblies; G

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; G

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.
1.4 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Government Representative.

1.4.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Government Representative." For Navy owned property, references to the "owner" shall be interpreted to mean the "Government Representative." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's
recommendations, and as approved by the Government Representative. Replace damaged or defective items.

1.6 PERFORMANCE REQUIREMENTS

1.6.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Government Representative shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05 05 23 WELDING, STRUCTURAL.

1.6.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with Section 26 42 00.00 12 CATHODIC PROTECTION.

1.7 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.
2.1 Materials

Materials for various services shall be in accordance with TABLES I and II. PVC pipe shall contain a minimum of 25 percent recycled content in accordance with ASTM F1760. HDPE pipe shall contain a minimum of 25 percent post-consumer recycled content. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen faucets, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310


c. Couplings for Grooved Pipe: Ductile Iron ASTM A536 (Grade 65-45-12), Malleable Iron ASTM A47, Grade 32510.

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have
a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

g. Solder Material: Solder metal shall conform to ASTM B32.

h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.


p. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105. Blind flange material shall conform to ASTM A516 cold service and ASTM A515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193.

q. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

r. Copper tubing shall conform to ASTM B88, Type K, L or M.

s. Heat-fusion joints for polypropylene piping: ASTM F2389.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:


b. Hose Clamps: SAE J1508.

c. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

d. Metallic Cleanouts: ASME A112.36.2M.

e. Plumbing Fixture Setting Compound: A preformed flexible ring seal
molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

2.1.3 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.2 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
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<tbody>
<tr>
<td>Butterfly Valves</td>
<td>MSS SP-67</td>
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<tr>
<td>Cast-Iron Gate Valves, Flanged and Threaded Ends</td>
<td>MSS SP-70</td>
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<td>Cast-Iron Swing Check Valves, Flanged and Threaded Ends</td>
<td>MSS SP-71</td>
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<tr>
<td>Ball Valves with Flanged Butt-Welding Ends for General Service</td>
<td>MSS SP-72</td>
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<tr>
<td>Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends</td>
<td>MSS SP-110</td>
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<td>Cast-Iron Plug Valves, Flanged and Threaded Ends</td>
<td>MSS SP-78</td>
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<td>Bronze Gate, Globe, Angle, and Check Valves</td>
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<td>Vacuum Relief Valves</td>
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<td>Water Pressure Reducing Valves</td>
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Description                                      Standard
Water Heater Drain Valves                      ASSE 1005
Trap Seal Primer Valves                        ASSE 1018
Temperature and Pressure Relief Valves        ANSI Z21.22/CSA 4.4
for Hot Water Supply Systems

2.2.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.2.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.2.3 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.2.4 Lawn Faucets

Lawn faucets shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 3/4 inch pipe. Body shall be suitable for wrench grip. Faucet spout shall have 3/4 inch exposed hose threads. Faucet handle shall be securely attached to stem.

2.2.5 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.2.6 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and
pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.3 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1. ASME A112.19.3/CSA B45.4 302 stainless steel, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains.

2.3.1 Lavatories

Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled.

2.3.2 Flush Valve Water Closets

ASME A112.19.3/CSA B45.4 302 Stainless Steel, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated closed-front seat with cover.

Water flushing volume of the water closet and flush valve combination shall not exceed 1.6 gallons per flush.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

2.3.3 Flush Valve Urinals

ASME A112.19.3/CSA B45.4 302 stainless steel, wall-mounted, wall outlet,
siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.0 gallon per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture.

2.3.4 Service Sinks

ASME A112.19.2/CSA B45.1, white vitreous china with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 0.75 inch external hose threads.

2.4 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.5 DRAINS

2.5.1 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

2.5.2 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.6.4, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast
For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.6 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility company. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

2.7 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

SECTION 22 00 00 Page 23
2.8 MISCELLANEOUS PIPING ITEMS

2.8.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.8.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.8.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.8.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.8.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.8.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.8.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

a. Identification of the sensor and its operation with written description.
PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 24 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.
3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Government Representative.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or
directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

Rigid grooved pipe couplings shall be for use with grooved end pipes, fittings, valves and strainers. Rigid couplings shall be designed for not less than 125 psi service and appropriate for static head plus the pumping head, and shall provide a watertight joint.

Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations.

The Government Representative shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.
3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.2.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.6 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

d. Press connection. Copper press connections shall be made in strict accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer of that joint. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.2.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of
Schedule 40 Pipe is not allowed), or mated flanged.

3.1.2.8 Polypropylene Pipe

Joints for polypropylene pipe and fittings shall be made by heat fusion welding socket-type or butt-fusion type fittings and shall comply with ASTM F2389.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with Section 26 42 00.00 12 CATHODIC PROTECTION. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulk ing and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in
the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above.
A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs "Flashing Requirements" and "Waterproofing", a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in
accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe
risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Government Representative. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.
3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.2.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.
3.2.2 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1.

3.2.3 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.2.3.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.2.3.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.2.3.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.2.3.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.2.4 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers
shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.2.5 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.2.6 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.4 IDENTIFICATION SYSTEMS

3.4.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4.2 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the
approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room.

3.5 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.6 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.6.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.6.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat
shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.7 TESTS, FLUSHING AND DISINFECTION

3.7.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Government Representative for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.


3.7.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

<table>
<thead>
<tr>
<th>Data on Device</th>
<th>Data on Testing Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Assembly</td>
<td>Name</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Address</td>
</tr>
<tr>
<td>Model Number</td>
<td>Certified Tester</td>
</tr>
</tbody>
</table>
If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.7.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.7.3 System Flushing

3.7.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Government Representative (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.7.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.
3.7.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.
b. Water pressures at the most remote and the highest fixtures.
c. Operation of each fixture and fixture trim.
d. Operation of each valve, hydrant, and faucet.
e. Pump suction and discharge pressures.
f. Temperature of each domestic hot-water supply.
g. Operation of each floor and roof drain by flooding with water.
h. Operation of each vacuum breaker and backflow preventer.
i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.7.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.
After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the Government Representative. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.9 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.
### TABLE I

**PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS**

<table>
<thead>
<tr>
<th>Item #</th>
<th>Pipe and Fitting Materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A536 and ASTM A47</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47 for use with Item 5</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td>Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 5</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>8</td>
<td>Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B75 C12200, ASTM B152, C11000, ASME B16.22 ASME B16.22 for use with Item 5</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>9</td>
<td>Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
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<td>10</td>
<td>Steel pipe, seamless galvanized, ASTM A53, Type S, Grade B</td>
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<td>X</td>
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<td></td>
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<tr>
<td>11</td>
<td>Seamless red brass pipe, ASTM B43</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Bronzed flanged fittings, ASME B16.24 for use</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td></td>
<td>with Items 11 and 14</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Seamless copper pipe, ASTM B42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Cast bronze threaded fittings, ASME B16.15</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>16</td>
<td>Copper drainage tube, (DWV), ASTM B306</td>
<td>X*</td>
<td>X</td>
<td>X*</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D2661, ASTM F628</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>20</td>
<td>Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>21</td>
<td>Process glass pipe and fittings, ASTM C1053</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>22</td>
<td>High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A518</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Polypropylene (PP) waste pipe and fittings, ASTM D4101</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>24</td>
<td>Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D2996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**SERVICE:**

A - Underground Building Soil, Waste and Storm Drain  
B - Aboveground Soil, Waste, Drain In Buildings
### TABLE I
**PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS**

<table>
<thead>
<tr>
<th>Item #</th>
<th>Pipe and Fitting Materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
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<tbody>
<tr>
<td>C</td>
<td>Underground Vent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Aboveground Vent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Interior Rainwater Conductors Aboveground</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Corrosive Waste And Vent Above And Belowground</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*</td>
<td>Hard Temper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

### TABLE II
**PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Pipe and Fitting Materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Malleable-iron threaded fittings,</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>a. Galvanized, ASME B16.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for use with Item 4a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Same as &quot;a&quot; but not galvanized</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>for use with Item 4b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Grooved pipe couplings, ferrous pipe</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASTM A536 and ASTM A47,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>non-ferrous pipe, ASTM A536 and ASTM A47,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ductile iron grooved joint fittings</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for ferrous pipe ASTM A536 and ASTM A47,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for use with Item 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Steel pipe:</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>a. Seamless, galvanized,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASTM A53, Type S, Grade B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Seamless, black,</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>ASTM A53, Type S, Grade B</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Seamless red brass pipe,</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>ASTM B43</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bronze flanged fittings,</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td></td>
<td>ASME B16.24 for use with Items 5 and 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td>Seamless copper pipe, ASTM B42</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Seamless copper water tube,</td>
<td>X**</td>
<td>X**</td>
<td>X**</td>
<td>X***</td>
</tr>
</tbody>
</table>
### TABLE II

**PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Pipe and Fitting Materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>ASTM B88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>Cast bronze threaded fittings, ASME B16.15 for use with Items 5</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Wrought copper and bronze solder-joint pressure fittings, ASME</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B16.22 for use with Items 5, 7 and 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>Cast copper alloy solder-joint pressure fittings, ASME B16.18</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for use with Item 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Bronze and sand castings grooved joint pressure fittings for non-</td>
<td>X</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>ferrous pipe ASTM B584, for use with Item 2</td>
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<tr>
<td>13</td>
<td>Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>outside diameter ASTM D2447</td>
<td></td>
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<tr>
<td>14</td>
<td>Polyethylene (PE) plastic pipe (SDR-PR), based on controlled</td>
<td>X</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>outside diameter, ASTM D3035</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td>Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled</td>
<td>X</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inside diameter, ASTM D2239</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for use with Items 14, 15, and 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Socket-type polyethylene fittings for outside diameter-controlled</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>polyethylene pipe, ASTM D2683 for use with Item 15</td>
<td></td>
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<td></td>
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<tr>
<td>18</td>
<td>Polyethylene (PE) plastic tubing, ASTM D2737</td>
<td>X</td>
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<td></td>
<td></td>
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<tr>
<td>19</td>
<td>Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water</td>
<td>X</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>distribution system, ASTM D2846</td>
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<td></td>
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</tr>
<tr>
<td>20</td>
<td>Chlorinated polyvinyl chloride</td>
<td>X</td>
<td>X</td>
<td></td>
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</tbody>
</table>
## TABLE II

**PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Pipe and Fitting Materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CPVC) plastic pipe, Schedule 40 and 80, ASTM F441</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>21</td>
<td>Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>22</td>
<td>Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437, for use with Items 20, and 21</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>23</td>
<td>Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438, for use with Items 20, 21, and 22</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>24</td>
<td>Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 80, ASTM F439, for use with Items 20, 21, and 22</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>25</td>
<td>Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>26</td>
<td>Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D2241</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>27</td>
<td>Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>28</td>
<td>Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 26 and 27</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<td>29</td>
<td>Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2464</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>30</td>
<td>Joints for IPS PVC pipe using solvent cement, ASTM D2672</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>31</td>
<td>Polypropylene (PP) plastic pipe and fittings; ASTM F2389</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>32</td>
<td>Steel pipeline flanges, MSS SP-44</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>33</td>
<td>Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Item No.</td>
<td>Pipe and Fitting Materials</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>34</td>
<td>Carbon steel pipe unions, socket-welding and threaded, MSS SP-83</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Malleable-iron threaded pipe unions ASME B16.39</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Nipples, pipe threaded ASTM A733</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F877</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>38</td>
<td>Press Fittings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A - Cold Water Service Aboveground
B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground
C - Compressed Air Lubricated
D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

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DIVISION 22 - PLUMBING

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VERTICAL PUMPS, AXIAL FLOW

07/07

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  1.4.2   Capacities
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1.6   QUALITY ASSURANCE
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    2.6.3.1 General
    2.6.3.2 Test Setup
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  2.6.3.7 Witness Test
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PART 1     GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor and materials, and performing all operations in connection with the installation of three (3) vertical pumps axial flow line shaft pumps in accordance with these specifications and applicable drawings.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 12 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)


AMERICAN PETROLEUM INSTITUTE (API)

API RP 686 (2009) Recommended Practice for Machinery Installation and Installation Design

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C200 (2012) Steel Water Pipe – 6 In. (150 mm) and Larger


AWWA C207 (2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1 (2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)


Martensitic Stainless Steel, Ultrasonic Examination Thereof


HYDRAULIC INSTITUTE (HI)

HI 2.6 (2000) Vertical Pump Tests


HI 9.8-2012 American National Standard for Rotodynamic Pumps for Pump Intake Design

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA RP2.1 (1978) Manometer Tables

1.4 SYSTEM DESCRIPTION

Design, furnish, and install three (3) identical vertical axial flow, line shaft pumps.

1.4.1 Design Requirements

a. Pumps are for the purpose of pumping water from canals to conveyance channel. Water pumped will not exceed 90 degrees F, will be relatively turbid, and may contain sand, silt, and vegetative trash capable of passing trashrack. Trash-racks will have 3 inch clear openings. Pumps shall be designed to operate in the dry.

b. Pumps shall be driven by the natural gas engines described in Section 41 65 10.00 10NATURAL GAS FUELED ENGINE PUMP DRIVES, through right angle, vertical shaft, reducers described in Section 33 45 00.00 10, SPEED REDUCERS FOR STORM WATER PUMPS.
c. Pumps shall discharge into discharge systems shown. System loss curves, which include friction losses from pump discharge elbows to ends of discharge lines, including bend losses, exit losses, and velocity heads, is included to permit determination of total head. Losses within pumps shall be determined by the Contractor.

1.4.2 Capacities

Each pump shall have the following capacities:

a. Rated Discharge not less than 56,100 GPM against 9.75 feet design Total Head. The Contractor shall vetify the design head based on the water levels and the system piping as shown on the drawings. The priming head is estimated at 14.0 ft TDH or as determined by the Contractor based on the system specifications and drawings provided and the water levels in the suction and discharge bays. The pumping system shall be designed to overcome the priming head without any vacuum assist.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

Detail drawings, as specified, within 60 days of notice of award of contract.

SD-03 Product Data

Materials

Two (2) copies of purchase orders, mill orders, shop orders for materials, and work orders, including orders placed or extended by each supplier. Furnish list designating materials to be used for each item at time of submittal of drawings. Furnish, within 60 days of notice of award, names of manufacturers of machinery and other equipment which Contractor contemplates incorporating in the work, together with performance capacities and other relevant information pertaining to the equipment.

Spare Parts

Six (16) Copies of manufacturer's complete parts list showing all parts and spare parts and bulletins for pumps. Clearly show all details and parts, and adequately describe parts or have proper identification marks.

Total Head; G

Computations of total design head and losses.
Shipping Bills

Two (2) copies of certified shipping bills, in duplicate, mailed promptly to Government Representative.

Dynamic Analysis; G

Detailed analysis report.

Installation and Erection Instructions Manual

No later than time of pump delivery, furnish six (6) copies of typed or printed, and bound, manual describing procedures to be followed by erecting engineer in erecting, assembling, installing, and dry-and wet-testing pumps.

Field Tests

Prior to proceeding with construction of the test setup but not later than 60 days after date of notice to proceed, a description of the test setup and test procedure proposed. Include dimensioned drawings and cross-sectional views of the setups and pumps, respectively, with location of instruments and points of their connection shown.

SD-04 Samples

Materials

Samples of materials as directed. Equipment, materials, and articles installed or used without the approval of the Government Representative shall be at risk of subsequent rejection.

SD-06 Test Reports

Witness Test

Notification that the witness test is ready to be run along with curves and sample calculations required by paragraph "WITNESS TEST".

Factory Test

A factory test report as required by paragraph "TEST REPORT".

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions Manual; G

Six (6) copies of manual containing complete information on operation, lubrication, adjustment, routine and special maintenance, disassembly, repair, reassembly, and trouble diagnostics of each pump and auxiliary unit. Operation and maintenance manual and both parts lists shall be printed on good quality ANSI size A 8-1/2 by 11-inch paper, bound separately between flexible, durable covers. Drawings incorporated in manual or parts lists, may be reduced to page size provided they are clear and legible, or may be folded into the manual to page size. Photographs or catalog cuts of components may be included for identification.
1.6 QUALITY ASSURANCE

Furnish one or more competent erecting engineers fluent in English language who is knowledgeable about the installation of the vertical pumps and associated drive machinery. Erecting engineers provided by this section shall include those from Contractor's suppliers. When so requested, erecting engineers shall provide and be responsible for providing complete and correct direction during initial starting and subsequent operation of equipment until field tests are completed. Erecting engineer shall initiate instructions for actions necessary for proper receipt, inspection, handling, uncrating, assembly, and testing of equipment. The Erecting Engineer(s) shall also keep a record of measurements taken during erection, and shall furnish one copy to Government Representative on request or on completion of installation of assembly or part. Erecting engineer shall instruct Government Representative in operation and maintenance features of work.

1.6.1 Freeze Protection

All parts of the pumps shall have drain holes to eliminate trapped water that could freeze. These drain provisions shall be self-draining without any requirement to enter the sump.

1.6.2 Detail Drawings

Submit drawings of sufficient size to be easily read. Submit information in the English language. Dimensions shall be in English. Drawings requiring changes as a result of pump tests should be submitted within 50 days after approval of tests.

   a. Outline drawings of pumps showing pertinent dimensions and weight of each component of the pumps.

   b. Drawing showing details and dimensions of pump mounting designs or layouts including any embedded items and the FSIs.

   c. Cross-sectional drawings of pumps showing each component. Show major or complicated sections of pumps in detail. Indicate on each drawing an itemized list of components showing type, grade, and class of material used and make and model number of standard components used.

   d. Detail and assembly drawings of entire pump units. Include all dimensions required to manufacture pumps.

   e. Drawings covering erection and installation, which Contractor intends to furnish to erecting engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 General

Furnish major pump components with lifting lugs or eye bolts to facilitate handling. Design and arrange lugs or bolts to allow safe handling of pump components singly or collectively as required during shipping, installation, and maintenance. Furnish shipping bills or memorandums of all shipments of finished pieces or members to designated site, giving designation mark and weight of each piece, number of pieces, total weight, and if shipped by rail in carload lots, car initial and number.
1.7.2 Processing for Storage

Prepare pumps (and spare parts) for storage indoors. Indoor storage consists of a permanent building that has leak-proof roof, full walls to contain stored equipment, and a concrete floor or temporary trailers. A temporary structure may also be built at job site for equipment storage that will contain features of the permanent building above except that provision for ventilation will be provided and floor may be crushed rock. A vapor barrier will be provided below the crushed rock. Crushed rock will be of sufficient thickness so that settlement of equipment will not occur. Equipment stored on crushed rock will have cribbing under each support location so that equipment does not come in contact with crushed rock. A plastic barrier will be placed between equipment and wood cribbing. Submit a list of equipment and materials requiring humidity-controlled storage to Government Representative no later than 30 days prior to shipment of pumping units. Long term storage (greater than 6 months) requirements shall be in accordance with pump manufacturer's recommendations.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Datum

Elevations shown in the plans or referred to in specifications, are referenced to the NAVD 88 (2004.65).

1.8.2 Static Head

Static head is the difference, in feet, between water surface elevation immediately inside trashrack and top of discharge pipe at highest elevation. Total priming head includes static head, friction losses outside of equipment being furnished, plus velocity head losses.

Pool-to-pool or design head is the difference in feet between the design water surface elevation in the sump bay and design water surface elevation in discharge channel. Pump manufacturer shall determine total head. Total head includes losses from the water surface on suction side of pump to discharge water surface.

1.9 MAINTENANCE

1.9.1 Special Tools

Furnish one set of all "special tools" required to completely assemble, disassemble, or maintain pumps. "Special tools" refer to oversized or specially dimensioned tools, special attachment or fixtures, or any similar items. If required, provide a device for temporarily supporting pump shafts and impellers during assembly, disassembly, and reassembly of gear reducers when thrust bearings are not in place. Lifting devices required for use in conjunction with crane shall be furnished. Provide portable steel cabinet large enough to accommodate all "special tools" furnished under this paragraph and as required by Sections 41 65 10.00 10 DIESEL FUELED ENGINE PUMP DRIVES and 33 45 00.00 10 SPEED REDUCERS FOR STORM WATER PUMPS. Mount cabinet on four rubber-tired casters. Provide drawers to accommodate tools. Fit front of cabinet with doors hinged to swing horizontally. Furnish doors with necessary stops, catches, and hasps for completely securing cabinet with a padlock. Furnish padlock complete with three keys. Pack "special tools" in wooden boxes if size
and weight do not permit storage in tool cabinet. Provide slings if box and tools are heavier than 75 pounds.

1.9.2 Extra Materials

Furnish the following spare parts:

a. One complete replacement set of bearings, bearing shells, journal sleeves, shaft coupling, if applicable, and seals for each pump.

b. One complete replacement set of wearing parts for the packing gland for each pump, and sufficient packing for all pumps.

c. Fifty percent of each size and length of bolt, nut and washer used on each pump assembly.

d. One oil storage container including drip device and solenoid oil valve.

e. One complete pump shaft for each station, including keys and thrust collars.

f. One complete main pump impeller for each station. All spare parts shall be duplicates of the original parts furnished and shall be interchangeable therewith. Spare parts shall be packed in crates as specified in paragraph "PROCESSING FOR STORAGE", subparagraph "GENERAL". If the crates and parts are heavier than 75 pounds, slings should be provided.

PART 2 PRODUCTS

2.1 MATERIALS

If not specified, materials and fabrication shall conform to the requirements of Section 05 50 04.01 12 MISCELLANEOUS, STANDARD ARTICLES, SHOP FABRICATED ITEMS. Material selection not specified shall be guided by HI 9.1-9.5 for corrosion, erosion, and abrasion resistance. Deviations from the specified materials shall be submitted in accordance with paragraph SUBMITTALS.

a. The pumps shall be identified by means of a separate name-plate permanently affixed in a conspicuous location. The plate shall bear the manufacturer's name, model designation, serial number if applicable, and other pertinent information such as horsepower, speed, capacity, type, direction of rotation, etc. The plate shall be made of corrosion-resisting metal with raised or depressed lettering and contrasting background.

b. The pumps shall be equipped with suitably located instruction plates, including any warnings and cautions, describing any special and important procedures to be followed in starting, operating, and servicing the equipment. Plates shall be made of corrosion-resisting metal with raised or depressed lettering and contrasting background.

c. Safety guards and/or covers shall be provided wherever necessary to protect the operators from accidental contact with moving parts. Guards and covers shall be of sheet steel, expanded metal, or another acceptable material and removable for disassembly of the pumps.
### 2.2 METALWORK FABRICATION

#### 2.2.1 Designated Materials

Designated materials shall conform to the following specifications, grades, and classifications.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>GRADE</th>
<th>CLASS</th>
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<tr>
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<td>ASTM A 351/A 351M</td>
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<td>AWWA C208</td>
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<td>Hot-Rolled Stainless</td>
<td>Graded G10200 and G11410</td>
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<td>ASTM A 576</td>
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<td>Ring Flanges</td>
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<td>Seamless and Welded Aust. Stainless Steel Pipe</td>
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<td>Steel Forgings</td>
<td>Class F</td>
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<tr>
<td>Steel Pipe 6 inches and Larger</td>
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<td>AWWA C200</td>
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### MATERIALS AND METALWORK FABRICATION

#### DESIGNATED MATERIALS

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<th>CLASS</th>
<th>SPECIFICATION</th>
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#### BOLTED CONNECTIONS

**2.2.2 Bolts, Nuts, and Washers**

Bolts, nuts, and washers shall conform to requirements of paragraph MATERIALS AND METALWORK FABRICATION, subparagraph DESIGNATED MATERIALS, and paragraph VERTICAL PUMPS, subparagraph PUMP COLUMN AND DISCHARGE ELBOW, subparagraph NUTS AND BOLTS for types required. Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to bolt axis.

**2.2.2.2 Materials Not Specifically Described**

Materials not specifically described shall conform to latest ASTM specification or to other listed commercial specifications covering class or kinds of materials to be used.

#### METALWORK

**2.2.3 Flame Cutting of Material**

Flame cutting of material other than steel shall be subject to approval of Government Representative. Shearing shall be accurately done, and all portions of work neatly finished. Steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a smooth surface free from cracks and notches is secured. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1/D1.1M. Chipping and/or grinding will not be required except where specified and as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Visible or exposed hand-guided cuts shall be chipped, ground, or machined to metal free of voids, discontinuities, and foreign materials.

**2.2.3.2 Alignment of Wetted Surfaces**

Exercise care to assure that correct alignment of wetted surfaces being joined by a flanged joint is being obtained. Where plates of the water passage change thickness, transition shall occur on the outer surface, leaving inner surface properly aligned. When welding has been completed and welds have been cleaned, but prior to stress relieving, joining of plates shall be carefully checked in the presence of Government inspector for misalignment of adjoining parts. Localized misalignment between inside or wetted surfaces of an adjoining flange-connected section of pumps or formed suction intakes shall not exceed amount shown in Column 4 of Table 1 for the respective radius or normal distance from the...
theoretical flow centerline. Misalignments greater than allowable amount shall be corrected by grinding away offending metal, providing the maximum depth to which metal is to be removed does not exceed amount shown in Column 5 of Table 1. No metal shall be removed until Contractor has assured himself and Contractor Officer that no excessive stresses will occur in remaining material and that excessive local vibration will not result from removal of the material. Where required correction is greater than the amount in Column 5 of Table 1, pipe shall be rejected for use. Proposed procedure for all corrective work, other than minor grinding, shall be approved by Government Representative prior to start of corrective work. Corrective work shall be finished by grinding corrected surface to a smooth taper. Length of the taper along each flow line element shall be 10 times the depth of the offset error at flow line. Wetted surface irregularities that might have existed in an approved model shall not be reason for accepting comparable surface irregularities in prototype pump.

TABLE 1

<table>
<thead>
<tr>
<th>(1)</th>
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<td>Pipe Thickness Inches</td>
<td>Maximum Offset Inches</td>
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2.2.3.3 Stress-Relieving Procedure

After all fabrication welding is completed, and prior to any machining, stress-relieve bell by heat treatment. Submit proposed stress-relieving procedure for approval by the Government Representative.

2.2.4 Examination of Castings

All castings shall be cleaned and carefully examined for surface defects. All defects shall be further examined by nondestructive means. Examination personnel shall be qualified/certified in accordance with applicable ASTM requirements. The examination procedure and qualification of the examiner shall be submitted for approval. Examination tests shall be made in the presence of the Government Representative. Choose the examination procedure best suited for the application.

2.2.4.1 Examination Procedures

a. Ultrasonic - Inspection shall conform to the applicable provisions of ASTM A 609/A 609M.

b. Magnetic Particle - Inspection shall conform to the applicable provisions of ASTM E 709.
c. Liquid Penetrant - Inspection shall conform to the applicable provisions of ASTM E 165.

2.2.4.2 Acceptance and Repair Criteria

Acceptance and repair criteria shall be in accordance with Section 05 50 04.01 12 MISCELLANEOUS, STANDARD ARTICLES, SHOP FABRICATED ITEMS.

2.3 VERTICAL PUMPS

2.3.1 Speed

Rotative speed of pumps shall be no greater than 600 rpm.

2.3.2 Reverse Flow

Pumps shall withstand, with no damage, the full force exerted on them, with impellers subjected to reverse flow and upper ends locked in place by backstops. Calculate head to determine the force developed by this reverse flow from specified highest discharge side water elevation and lowest pump intake side water elevation.

2.3.3 Efficiency

Pool-to-pool efficiency at head-capacity design condition specified in paragraph CAPACITIES shall not be less than 80 percent when calculated as follows:

\[
Efficiency = \frac{Q \times H}{3960 \times BHP} \times 100
\]

Where:
- \( Q \) = Discharge, gallons per minute
- \( H \) = Total head, feet
- \( BHP \) = Pump brake horsepower

Pump efficiency at design conditions, as defined in HI 2.6, shall include losses from the suction bell to the discharge elbow outlet and shall not be less than 84 percent at the head-capacity condition(s) specified in paragraph CAPACITIES.

2.3.4 Suction Bell (Formed Suction Intake)

Make suction bell of either cast iron, cast steel, or welded steel plate,. Provide flanged connection for mating with impeller bowl with a rabbet fit or four equally spaced dowels installed in the vertical position for initial alignment purposes and to maintain concentric alignment of pump. Steel plate, if used, shall have thickness of not less than 1/2 inch. Suction bell shall be made in one piece. Suction bell shall be supported entirely by pump casing. Supports from sump floor will not be acceptable, except those that are part of a formed suction intake.

2.3.5 Impeller Bowl

Make impeller bowl of either cast iron, cast steel, welded steel plate or a combination of cast steel and steel plate. Steel plate, if used, shall have thickness of not less than 1/2 inch after machining is completed. Welds shall be heat-treated stress-relieved before final machining.
Provide flanges for mating with suction bell and formed suction intake and impeller bowl. Flanged connections with suction bell and the diffuser or split construction shall be provided with a rabbet fit or four equally spaced dowels installed in the vertical position for initial alignment purposes and to maintain concentric alignment of pump. Machine finish impeller-swept area in impeller bowl to at least 125 microinch rms and concentric with impeller axis. For mixed-flow impellers, angle in impeller bowl shall equal the outside angle of impeller blade tips. Tolerance for concentricity of impeller with the impeller axis shall not be greater than 20 percent of the operating clearance between impeller and impeller bowl.

2.3.6 Diffuser Bowl

Make diffuser bowl of cast iron, cast steel, welded steel plate, or a combination of cast steel and steel plate. Steel plate, if used, shall have thickness of not less than 1/2 inch after machining is completed. Diffuser shall contain support for upper impeller shaft bearing and have vanes to guide the pumped flow. Equip diffuser bowl with a bypass drain to outside of pump from the diffuser cavity located between the enclosing tube connection and impeller. Furnish throttle bushing located in the cavity immediately above impeller. Bypass drain and throttle bushing should be designed to reduce water pressure on lower seal. Impeller back-wear rings can also be used to reduce water pressure on lower seal.

2.3.7 Pump Column and Discharge Elbow

2.3.7.1 Column and Discharge Elbow

Make column and discharge elbow of either cast iron, cast steel, or welded steel plate. Steel plate, if used, shall have thickness of not less than 3/8 inch after machining is completed. Elbow shall be of long radius typemitered type. Column and discharge elbow shall be designed to withstand internal pressures and external loadings associated with various conditions of pump operation. Provide flanges for mating individual segments together and for mating pump column to diffuser bowl. Flanges shall have rabbeted fits or four equally spaced dowels installed in flanges for initial alignment purposes and to maintain concentric alignment. The elbow shall terminate in a plain-end circular section. Diameter of discharge end of elbow shall be as shown and shall allow standard diameter flexible couplings to be used. Adjustable thrust rods and thrust lugs shall be used to transfer the load by bridging the coupling.

2.3.7.2 Column and Discharge Elbow Support

Pump column and discharge elbow shall be designed for suspension from a baseplate assembly specified in paragraph BASE PLATE AND SUPPORTS and located at operating floor level.

2.3.7.3 Formed Suction Intake (FSI)

Design the formed suction intake based on the HI standards HI 9.8-2012 as part of the suction to the pump.

a. Provide FSI water passage with pumps, sized to fit within limiting elevations and dimensions shown. No bearings shall be located below the impeller when FSI is used.
b. Dimensions of intake elbow and conical transition section of FSI are relative to diameter at the top of cone, as defined on drawings. Diameter at top of cone and related dimensions are determined to accommodate the size of pump, providing limiting values for discharge and submergence are not exceeded, floor of the FSI remains at elevation shown on the plans, and impeller datum is set no higher than elevation shown on the plans. Rectangular transition section of the FSI upstream of elbow can be modified in length to match width of individual pump bay or sump intake. Modification shall be limited to surfaces and dimensions indicated, and shall be approved.

c. Construct FSI of fabricated steel. Stiffeners used shall be on outside of the FSI to allow smooth flows in the FSI. Size subassemblies of the FSI, to permit placement and removal through sump gate and trashrack. Bolts used to connect flanges shall be stainless steel with bronze nuts. Minimum thickness of fabricated material shall be 1/2 inch for fabricated portions.

d. FSI connection to pump impeller bowl flange shall be designed by the pump manufacturer and be rigid or flexible as indicated by results of the dynamic analysis required in paragraph DYNAMIC ANALYSIS. Submit design and drawings indicating materials of construction and method of assembly of the FSI for approval.

2.3.7.4 Flanges

Machine flanges and drill bolt holes concentric with pump shaft vertical centerline, having tolerance of plus or minus one fourth of clearance between bolt and bolt hole. When fabricated from steel plate, flanges shall not be less than 1-1/2 inch thick after machining. Flange thickness after machining shall not vary more than 10 percent of greatest flange thickness. Provide external stiffeners, if needed. Construct fabricated flanges, as a minimum, to the dimensions of AWWA C207, Class B. Flanges on major components of pump casing (suction bell, impeller bowl, diffuser bowl, and column and elbow piping) shall be designed such that blind holes necessitating use of cap screws or stud bolts will not be used. Design flanges for connection to column pipe by at least two continuous fillet welds. One weld shall connect inside diameter of flange to pump column and the other shall connect outside diameter of pump column to flange. Final design of welds rests with manufacturer, and specified welds are the minimum requirement. They shall be parallel machined, when provided on each end of the same component, and mounted parallel to a plane that is normal to pump shaft centerline. Flanges on each end of the same component shall have parallel tolerance of 0.002 inch. Finish machine mating surface on flange to 125 microinch finish or better. Provide flanges with minimum of three jacking bolts to aid in disassembly of pump.

2.3.7.5 Flanged Joints

Design flanged joints to be air-and water-tight, without the use of preformed gaskets, against positive and negative operating pressures that will be experienced, except that "PERMATEX" or equal gasketing compound will be permitted. Provide mating flanges, unless of the male-female rabbet type, with not less than four tapered dowels equally spaced around flange.

2.3.7.6 Nuts and Bolts

Bolts used in assembling pumps and their supporting members, including
anchor bolts and dowels, shall be of 300 series stainless steel. Use only bronze nuts and hexagonal bolts and nuts. Washers used shall be 300 series of stainless steel.

2.3.7.7 Galvanic Protection

When dissimilar metals are used, dissimilar parts shall be electrically isolated. Verify isolation by checking joint with an ohmmeter.

When dissimilar metals are used, use zinc anodes. Provide machined mounting pads and install anodes on carbon steel or cast iron parts. Fasten anodes to bare material on pump so that continuity is obtained between anode and pump. Verify continuity by checking joint with an ohmmeter. Locate anodes on exterior of pump below normal sump level. Total weight of anodes used per pump shall be 40 pounds or as determined by the manufacturer. Pump joints shall be electrically bonded at the joints.

2.3.7.8 Harnessed Coupling

Provide a flexible mechanical coupling conforming to ASTM F 1476, Type II, Class 3, stainless steel or Dresser style 38 or approved equal, to connect pump discharge elbow to discharge piping.

2.3.7.9 Discharge Piping

The plain end shall match pump discharge elbow in thickness and diameter. Fabricate flanges with a minimum dimension of AWWA C207, Class D, drill to match. Discharge piping shall be fabricated from steel plate.

2.3.8 Impellers

Make impellers of cast stainless steel.

2.3.8.1 Removal and Prior To Finishing

After removal from mold, and prior to finishing of surface imperfections, castings shall be inspected by the Government Representative. Minor surface imperfections shall be filled or ground down as necessary to preserve correct contour and outline of impeller and to restore surface imperfections to the same degree of finish as surrounding surfaces. Correct surface pits, depressions, projections, or overlaps showing greater than 1/16 inch variation from the general contour for that section. Method and procedure for accomplishing repair shall be as required in Section 05 50 04.01 12 MISCELLANEOUS, STANDARD ARTICLES, SHOP FABRICATED ITEMS. Castings that exhibit surface imperfections (as defined above) covering an area of more than 10 percent of blade surface will be rejected.

2.3.8.2 Balance

Balance impeller by the two-plane balancing technique. Impeller shall be balanced at rated operating speed. Check balance at 110 percent of balance speed, and make needed corrections. Amount of allowable unbalance shall be in accordance with grade G6.3 of ASA S2.19. Weights needed to obtain required level of balance shall be securely fastened to inside cavity of impeller hub. In no case will portions of the impeller be removed or weights be added to outside of hub, vanes, or water passages. Submit balancing procedure to the Government Representative for approval.
at least four weeks prior to date of balancing. Each finished impeller shall be weighted and weight stamped on the bottom of hub. Weight shall be accurate to 0.5 percent of the total weight of impeller. Weighing and balancing shall be witnessed by the Government Representative.

2.3.9 Shafting

2.3.9.1 Shaft

Impeller shaft shall be stainless steel and intermediate shaft(s) shall be same material as impeller shaft. Design shafting so that any necessary vertical adjustment of impeller can be made from operating room floor without interfering with shaft alignment. Also provide for removal of impeller from below without disassembly of pump above impeller bowl. Design shafts for two different design cases. The first uses a factor of safety of 5 based on ultimate tensile strength of shaft material and rated horsepower of engine. The second uses 75 percent of the yield strength of shaft material and maximum horsepower of engine.

2.3.9.2 Couplings

Pump and gear reducer shafts and pump shaft sections shall be coupled together using rigid flanged couplings capable of transmitting the forces and torques involved. Coupling halves shall be bolted together and shall be maintained concentric with each other, by means of a rabbet fit, to within 0.002 inch. Shaft coupling nut, if used, shall be retained by fitted bolts, and all tolerances specified for the coupling shall apply. Finish machine the flange and bore in one setup to insure that flange of coupling shall be true to the bore. Flange shall be perpendicular to the bore, and parallel to the opposite end and mating flanges to within 0.002 inch. Flange shall be concentric to centerline of shaft to within 0.002 inch. Pump shaft sections shall be joined together with sleeve-type couplings capable of taking rotation in either direction. Threads, except on fasteners, shall not be employed in construction of sleeve-type couplings. Couplings, including keys and fasteners, shall be constructed of stainless steel materials. The finished shaft assembly shall be concentric about shaft centerline to within 0.004 inch. Shop assemble couplings and pump shaft and inspect for compliance with contract requirements. After inspection, matchmark parts, including fitted bolts, to their mating pieces.

2.3.9.3 Journals

Provide replaceable stainless steel one-piece journal sleeves at each guide bearing, packing gland and seal location. Finish sleeves at all bearings and packing gland locations to at least 32 micro-inches and finish sleeve at seal locations to 16 micro-inches. Securely fasten sleeves to shaft to prevent movement. Keys and fasteners, if used, shall be made from corrosion resisting steel; fastening by adhesive or welding is not acceptable. The surface hardness of the sleeves at the bearing and packing gland locations shall be as recommended by the pump manufacturer.

2.3.9.4 Circumferential Line

A circumferential line shall be inscribed or etched on shaft above stuffing box and an adjustable pointer shall be provided and mounted opposite this line in order to indicate a change in vertical position of shaft and to permit realignment after gear reducer removal.
2.3.10 Shaft Enclosure

Provide shaft enclosure to cover intermediate shaft and coupling. It shall be placed in tension or shall be rigid enough to be self-supporting. External supports or bracing located in pump water passage shall not be used for support of the enclosing tube unless necessary to support intermediate bearings or indicated to be necessary or advantageous by dynamic analysis required in paragraph DYNAMIC ANALYSIS. Consider effect of external supports, including rubber inserts, in the dynamic analysis required in paragraph TEST, INSPECTIONS, AND VERIFICATIONS, subparagraph DYNAMIC ANALYSIS. Design enclosure to be watertight and for easy assembly and disassembly in the field. Enclosing tubes constructed with screw type joints and using tension in tube to hold alignment, shall be constructed to prohibit tension tube from unscrewing when packing gland adjustments are made. Provide shaft enclosure for grease-lubricated pumps with a drain having a shut-off valve located on the outside to permit draining enclosure between operation periods. Locate drain at bottom of shaft enclosure. On oil-lubricated pumps, the enclosing tube below lowest bearing and above oil seals shall be fitted with an oil/water drain line to the outside of pump. Drain line shall have a check valve outside of pump to preclude entrance of sump water.

2.3.11 Guide Bearings and Seals

2.3.11.1 Guide Bearings

Provide pump with sleeve-type bearings designed for oil lubrication. Bearing shall have a bronze lining in contact with shaft journal and shall be replaceable type. Arrange bearing liner for maximum distribution of oil for lubrication of journal surface. Bearings shall have a surface finish of 32 microinches rms or better to match journal finish. Since pumped water may contain some fine sand and silt in suspension, give special attention to the design and selection of bearing parts, especially seal rings, to preclude entrance of foreign material between bearing and journal due to differential water pressure.

2.3.11.2 Oil Lubrication Shaft Seals

Pumps designed for oil lubrication shall have a shaft seal system located below upper pump shaft bearing. Seal system shall consist of a seal containing two lip elements. Element facing bearing shall have a stainless steel garter spring back-up and be constructed of TFE (Teflon). Secondary element shall face impeller and be constructed of TFE. Use bullet-shaped assembly tool or other special tool over end of shaft or grooves in shaft to preclude damage to lip element during assembly. Assembly tools used are considered a special tool and shall be furnished to Government as part of special tools specified in paragraph MAINTENANCE, subparagraph SPECIAL TOOLS. Pumps having two stages shall have seals to protect extra bearings required by two stages of construction.

2.3.12 Bearing Heat Sensors

Fit each bearing with temperature-sensing elements, inserted in bearings to within 1/8 inch of shaft. These temperature-sensing elements shall be provided with temperature readouts mounted on engine instrument board or at a central location as shown. Provide visual and audible alarm system to warn of bearing overheating. Support leads and protect from water and
mechanical damage. Terminate leads outside of pump casing in a waterproof connection head, Minco CH 339 or equal, and cap until final connections are made in the field. The connection head shall be rated watertight to 25 psi. Lead protection shall consist of pipes fastened to pump with brackets using bolts and nuts to permit their removal, and shall be constructed with enough unions to be completely disassembled. Leads passing through pump water passage shall either be contained in a guide vane or be protected by Schedule 80 pipe. Protection pipe shall be removable if connected to shaft-enclosing tube. Run leads and wiring to a junction box located on baseplate. Provide terminal strip in junction box for connection of wiring to temperature readouts.

2.3.13 Thrust Bearing

Provide thrust bearing in the speed reduction gear to carry total thrust load as determined by the pump manufacturer.

2.3.14 Packing Gland

Provide grease-lubricated packing gland split longitudinally to facilitate removal or renewal. Arrange it to permit inspection, repair, removal, or replacement of packing without entering pump from below operating room floor. Provide eye bolts and tapped holes in each half of the split gland if halves weigh over 30 pounds each.

2.4 LUBRICATION SYSTEM

Oil lubrication of shaft bearings shall consist of introducing oil at the top line shaft bearing and allowing oil to run down shaft for lubrication of lower bearings. Oil lubrication shall consist of an oil reservoir mounted on pump baseplate or pump driver at such height to permit gravity flow of oil to the highest lubrication point of pump shaft. Construct reservoir of transparent material to permit observation of quantity of oil in reservoir. Oil reservoir shall have a minimum capacity of 1 quart. Reservoir shall have a solenoid valve to permit oil flow whenever pump driver is in operation. Flow rate from oil reservoir shall be adjustable from five drips per minute to constant flow. Reservoir valve shall permit manual flow of oil when pump driver is not operating for prelubrication of shaft bearing. Construct oil line from oil reservoir to pump line shaft of stainless steel tubing and support at sufficient locations to preclude vibration of tubing when pump is operating. If pump has a bearing located below impeller, this bearing shall be grease-lubricated. Provide grease line with a grease fitting from this bearing to a location on top of baseplate. Provide a grease reservoir with this bearing configuration for containing extra grease. Shaft packing shall be lubricated by grease. Run grease lines to a location outside of driver pedestal and provide with a fitting for manual lubrication.

2.5 PAINTING

Perform painting in accordance with Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

2.6.1 Critical Speeds and Dynamic Analysis

Assembled pumping unit, consisting of engine, speed reducer and pump
shall be free from critical speeds or harmful torsional vibrations at all speeds encountered within the operating range.

2.6.1.1 Torsional Analysis

Before pump, gear drive, and engine are released for manufacture, engine supplier shall analyze the system for harmful torsional natural frequencies using mass elastic information provided by pump and gear drive manufacturers. A natural frequency that occurs within 25 percent above or below normal operating speed is considered to be unacceptable.

2.6.1.2 Lateral Frequency Analysis

Before pump, gear drive, and engine furnished under Section(s) 41 65 10.00 10 DIESEL ENGINE PUMP DRIVES and 33 45 00.00 10 SPEED REDUCERS FOR STORM WATER PUMPS, respectively, are released for manufacture, pump/gear drive structure shall be analyzed by pump manufacturer for harmful natural frequencies in the lateral directions. A natural frequency that occurs within 25 percent above or below any operating speeds required for pump operating conditions is considered to be harmful. The dynamic analysis model shall be constructed using a commercially available program such as Ansys, Cosmos/M, or equivalent that utilizes finite element methods. The model shall incorporate effects of column pipes, cover pipes, shafts, bearings, mass concentrations, and other such features as necessary to accurately model pump structure. Analyze structure in the run (wet) condition and consider the effect of water mass in the column and the damping effect of water in the sump at highest and lowest sump water levels. The model shall incorporate Reed critical frequency and mass elastic diagram information provided by gear drive manufacturer. If gear drive manufacturer cannot demonstrate to the satisfaction of the Government Representative (based on impact tests of similar units) that the Reed critical frequency value is accurate, a dynamic analysis using finite element methods as described herein shall be conducted by gear drive manufacturer to determine gear drive Reed critical frequency for use by pump manufacturer. Submit complete dynamic analysis report including the following information:

a. Computer program used.

b. Schematic diagram of the model depicting nodes and elements.

c. Input data consisting of node coordinates, element types, material properties, element characteristics, element connectivities, and specified displacements.

d. Gear mass elastic and Reed critical information (or dynamic analysis, if required).

e. Analysis results including all significant natural frequencies.

f. Interpretation of results.

Impact-test gear drive before shipment to determine the actual Reed critical frequency of the drive. Submit results of impact tests. Pump manufacturer shall address any discrepancy between calculated and actual gear drive Reed critical frequency values as to whether or not design changes are required to prevent harmful natural frequencies in pump/gear drive structure. If any design changes are required, these shall be incorporated at no cost to Government.
2.6.2 Lubricating System Tests

Test complete lubricating system for each pumping unit, as deemed necessary by the Government Representative, to determine that system meets operational requirements specified. At least one valve of each size furnished shall be tested with the lubrication line removed from its bearing and fitted with a pressure relief valve and pressure gage. The pressure relief valve shall be adjusted to discharge at the operating pressure specified and the system shall be operated through one or more cycles as required to obtain an accurate measurement of the quantity of lubricant delivered, which shall be within plus or minus 20 percent of the theoretical delivery of the respective valve. Any component parts that are damaged as the result of these tests or that fail to meet the requirements of the specification shall be replaced, reinstalled, and retested at the Contractor's expense.

2.6.3 Factory Test

2.6.3.1 General

Performance of the pumps to be furnished will be accepted on the basis of the factory tests. Conduct this test using first of each model of pump produced for this contract. Cavitation testing shall be performed in accordance with HI 2.6 if no published NPSHR curves are available.

2.6.3.2 Test Setup

Prototype Pumps - Prototype pumps shall be set with shaft in vertical position. Factory test elbow may be used in lieu of the prototype elbow for testing purposes, providing test results are adjusted to reflect the difference in losses. Tests shall be completed prior to assembling any pump except the one to be tested.

2.6.3.3 Instrumentation and Procedures

Each instrument shall be described in detail, giving all data applicable, such as manufacturer's name, type, model number, certified accuracy, coefficient, ratios, specific gravity of manometer fluid to be used, and smallest scale division. When necessary for clarity, sketch of instrument or instrument arrangement shall be included. Include fully detailed narrative description of each proposed method of instrumentation, procedures to be used, and a sample set of computations. State the lowest equivalent static head that is obtainable with the testing when operating along the head-capacity curve of proposed pump. Test procedures, except as specified, shall be in accordance with applicable provisions of HI 2.6.

a. Head Measurements - Make head measurements using either a direct reading water column, mercury-air, mercury-water, a Meriam fluid manometer, or a pressure transducer. Measure vacuums with either a mercury-air, a mercury-water manometer, or a pressure transducer. Fluctuations shall be dampened sufficiently to permit column gages or a differential pressure transducer to be read to either closest 0.01 foot of water or Meriam fluid or 0.1 inch of mercury. Manometers shall be used as indicated by ISA RP2.1. When pressure transducers are used, their accuracy shall be checked with a manometer.

b. Capacity - Determine capacity by calibrated venturi flowmeter or long-radius ASME flow nozzle. Do not use orifice plates. Connect
venturi or nozzle taps to column gages equipped with dampening devices that will permit differential head to be determined to either the closest 0.01 foot of water or Meriam fluid or 0.1 inch of mercury. Magnetic flowmeters and flowmeters utilizing ultrasonic flow measurements will be acceptable if calibration of flowmeter has been completed within the last 6 months.

c. Rotational Speed of Pump - Measure rotational speed of pump in accordance with "Method of Rotary Speed Movement" in HI 2.6, except that revolution counters shall not be used. Non-contacting hand-held electronic tachometers are acceptable. Device used shall permit speed to be determined to 1 rpm.

d. Power Input - Measure power input to pump in accordance with "Power Measurements" in HI 2.6. Use a method to permit pump brake horsepower to be determined to the closest 0.5 horsepower.

e. Cavitation Tests - The instruments to be used for these tests shall be selected by the Contractor and shall be of the type suited for cavitation testing. However, in no case shall the instruments used yield results less accurate than those obtained with the performance test.

2.6.3.4 Pump Test

Test shall demonstrate that proposed pump complies with specified performance. Pump shall be capable of operation without instability over entire range of heads specified in paragraph CAPACITIES. Instability is defined, for this specification, as when one or more of the following conditions occur:

a. Pump has two or more flow rates at the same total head;

b. Head-capacity curve has a dip (region on curve where change in flow rate produces an abnormally low head);

c. When any point in usable range of head-capacity curve cannot be repeated within 3 percent.

Rerun test if this occurs. Compliance with specifications will be determined from curves required by paragraph TEST RESULTS. Test procedures, except as specified, shall be in accordance with applicable provisions of HI 2.6. Temperature of water used for testing shall be approximately the same for all tests run and shall be recorded during test runs.

2.6.3.5 Test Procedure

a. Performance of The Pumps - The performance of the pumps shall be determined by a series of test points sufficient in number to develop a constant-speed curve over the range of total heads corresponding to the heads in paragraph CAPACITIES. The performance/test range shall include additional testing at total heads 2 feet higher than the total head determined in paragraph CAPACITIES. The lowest total head for testing shall be, as a minimum, the total head determined from paragraph "CAPACITIES". If the test setup permits testing at lower total heads, the range of total heads shall be extended 2 feet lower. Tests shall be made using prototype total heads. Head differentials between adjacent test points shall not exceed 3 feet,
but in no case shall less than 10 points be plotted in the pumping range. If the plot of the data indicates a possibility of instability or dip in the head-versus-capacity curve, a sufficient number of additional points on either side of instability shall be made to clearly define the head-capacity characteristics. When a scale model of the pump is tested, the efficiency of the prototype pump shall be considered to be the efficiency of the model. No other computation or adjustment of model efficiency to prototype conditions will be permitted.

b. Sump Elevations - Tests shall be conducted at two different sump elevations (approximately a 5 foot differential) to determine the effect of test sump geometry on the performance of the pump. Should the test results indicate that the performance is not the same in all respects for both sump conditions, take whatever corrective action is necessary to produce congruent results. One of the two sump elevations used may be at the specified design elevation. The test results with this sump elevation shall meet all specified conditions of capacity, head, and brake horsepower. Submit curves indicating test results.

c. Tests Results - Plot results of tests to show total head, brake horsepower and efficiency as ordinates; all plotted against pump discharge as the abscissa. Plot curves showing prototype performance to a scale that will permit reading head directly to 0.2 foot, capacity to 35,000 gpm, , efficiency to 1 percent, and power input to 250 horsepower.

d. Demonstration - Demonstrate to Government witness that the blade templates fit the tested pump. Demonstration shall be done immediately after testing is completed. Retain all templates for the tested pump, and furnish them to Government upon request of the Government Representative, to permit Government to verify geometric similarity with the manufacturer's pump. In addition to providing templates, furnish dimensioned drawings of impeller, which contain all dimensions needed to manufacture it. Tested impeller shall be stamped with identification marks. Provide necessary facilities and instruments needed to permit Government to verify that pumps are in complete geometric similarity with the tested pump.

2.6.3.6 Cavitation Tests (To be performed only if the certified test information is not available on the pump being provided)

a. Model Test - The model test shall include the determination of net positive suction head required (NPSHR) at five or more points on the constant speed curve. NPSHR shall, as a minimum, be determined for five or more capacities corresponding to prototype capacities over the total range of specified operating conditions. If the pump has a capacity greater than that specified for the lowest and/or highest operating condition, then these over-capacity conditions shall be used. The other test capacity points shall be equally spaced between the highest and lowest capacities.

b. NPSHR - NPSHR shall be determined on a constant-capacity, constant-speed basis, using arrangement Figure 2.62 or 2.63 as described under paragraph "Net Positive Suction Head Required Test" in HI 2.6. Suction conditions shall be varied to produce cavitation. NPSHR shall be the maximum value at which any one or all of the plotted curves, head, horsepower, and efficiency depart from the
constant values (point of tangency). A sufficient number of points to accurately locate the departure point shall be obtained.

c. Value of NPSHR - The value of NPSHR shall be 2 feet less than the corresponding available net positive suction head (NPSHA). NPSHA shall be determined using the temperature of the water in the model at the time the tests are run. The water elevations specified shall be used to determine the NPSHA for the pumps.

d. Plotting Test Results - The test results shall be plotted to the scales determined by the Government Representative at the time of the test. Curves showing total head, brake horsepower, and efficiency as ordinates and NPSH as the abscissa shall be drawn. In addition, curves showing NPSHR versus capacity shall be drawn with NPSH as the ordinate and capacity as the abscissa. NPSHA points shall be shown on the curves.

e. Curves - Should it be considered necessary by the Contractor to take into account measurement inaccuracies when drawing the curve needed to determine NPSHR in accordance with paragraph NPSHR, the following method shall be used. No other method will be acceptable. The inaccuracy shall be determined for each parameter, and the calculations shall be furnished to the Government Representative for approval. Using the calculated inaccuracy as the radius and the test point as the center, a circle shall be drawn for each test point. Two curves, one a maximum and the other a minimum, shall be drawn and shall pass through or touch each circle. The maximum curve shall touch the top and the minimum curve shall touch the bottom of as many circles as is practicable while maintaining smooth curves. Should the plot indicate that a test point is obviously erroneous, it may be ignored by mutual consent or the test may be rerun. Halfway between the maximum and minimum curves, another curve (the mean) shall be drawn. The point at which the mean curve departs from the constant values (point of tangency) shall be considered to be the NPSHR of the pump for the capacity at which the test was run.

2.6.3.7 Witness Test

When the Contractor is satisfied that the tested pump performs in accordance with the requirements of the specifications and the guaranteed values, he shall notify the Government Representative that the witness tests are ready to be run and shall furnish two copies of the curves required in paragraph PUMP TEST AND CAVITATION TESTS along with a set of sample calculations with constants and conversion factors. Two weeks will be required to review this data before the Government Representative will be available to visit the Contractor's laboratory for witnessing the test. Should the results of the witness test reveal that the tested pump does not perform in accordance with the requirements of the specification and the guaranteed values, make such changes as are required to make it acceptable before again notifying the Government Representative that the witness tests are ready to be run. Immediately upon completion of each witness test, copies of all data taken during the test shall be delivered to the Government Representative witnessing the test. Computations of test results and plotted preliminary curves shall be furnished to the witness.

2.6.3.8 Test Report

Submit, within 30 days of receipt of approval of the witness test, to
Government 7 bound copies of a report covering completely test setup, performance, and cavitation tests. Each test report shall include, as a minimum, the following:

a. Statement of the purpose of test, name of project, contract number, and design conditions should be given. Where guaranteed values differ from specified values, they also should be given.

b. A resume of preliminary studies, if such studies were made.

c. Description of test pump and motor, including serial numbers, if available. Information required under "b" may be included here.

d. Description of test procedure used, including dates, test personnel, any retest events, and witness test data.

e. List of all test instruments with model numbers and serial numbers.

f. Sample computations (complete).

g. A discussion of test results.

h. Conclusions.

i. Photographic evidence in the form of either 24 color photographs of test equipment, test setup and representative test segments, and a DVD, at least 30 minutes in length, covering the same information as photographs. All photographic evidence should be labeled with contract number, location, date/time, and test activity. DVD shall be voice annotated with the same information.

j. Copies of instrument calibration.

k. Copies of all recorded test data.

l. Curves required by paragraph TESTS RESULTS.

m. Curves showing the performance of the test pump.

n. Drawings of the test setup showing all pertinent dimensions and elevations and a detailed dimensioned cross section of the pump.

2.7 BASEPLATE AND SUPPORTS

The baseplate shall be proportioned to support the entire pump assembly, the reduction gear and the loads (including the results of the dynamic analysis) to which it may be subjected during operation. It shall be supported and anchored as shown on the drawings. Lifting lugs or eye bolts, special slings, strongbacks, or other devices necessary to handle the pump during loading, unloading, erection, installation, and subsequent disassembly and assembly shall be furnished. A sole plate shall be provided under the baseplate. The sole plate shall be installed, leveled and grouted in accordance with API RP 686, Chapter 5 - Mounting Plate Grouting. Jacking bolts shall be provided for leveling the baseplate assembly. An anchor bolt layout shall be provided to aid in placement of anchor bolts. All leveling jacking bolts shall be backed off after grouting so that they do not support any of the load. The pedestal supporting the right-angle reduction gear shall contain a 1-inch lip to contain water leakage from the shaft packing. A threaded drain to the
2.8 FACTORY ASSEMBLY

The pumps shall be assembled at the manufacturer's plant in a vertical position to assure proper fitting and alignment of all parts. Tolerances shall not exceed those specified or shown on the Contractor's manufacturing drawings. Rotating elements shall be checked for binding. The suction bell, impeller housing, diffuser, and the discharge elbow shall be properly match marked and have their centerlines clearly marked on the outside of all flanges to facilitate erection and alignment in the field. Notify the Government Representative sufficiently in advance to permit a representative of the Government Representative to inspect and witness the pump assembly. All parts disassembled for shipment shall be matchmarked.

PART 3 EXECUTION

3.1 INSTALLATION

a. The installation of the equipment furnished under this section and related drive machinery furnished under other sections of this specification shall be in accordance with the approved Installation and Erection Instructions Manual. To the extent necessary or desirable, coordinate and consolidate description of pumps with similar descriptions specified for gear reducers and diesel engines.

1) Descriptions shall be complete, orderly, step-by-step explanations of operations required, and shall also include such things as alignment procedures, bolt torque values, permissible blade/bowl clearances; permissible bowl out-of-roundness; permissible shaft misalignment; recommended instrument setups; recommended gages and instruments; bearing clearances; and similar details.

2) Descriptions shall be complemented and supplemented by drawings, sketches, photos, and similar materials to whatever extent necessary or desirable, and the overall result shall be a description that may be comprehended by an engineer or mechanic without extensive experience in erecting or installing pumps of this type.

b. The erection engineer(s), familiar with the equipment to be installed, shall supervise the handling, installation, start-up and testing of the equipment as required by paragraph "ERECTION ENGINEER(S)".

c. Submit an Operation and Maintenance Instructions Manual as specified in the Submittals paragraph.

3.2 FIELD TESTS

3.2.1 Wet Tests

Each pump unit shall be given a test under load, at or near normal operating conditions, for at least 4 hours or as directed by the Government Representative; the test will be witnessed by the Government. Provide all supplies and equipment required to conduct the test. During the test the operation of the pumps will be observed and measurements of
sound, vibration and bearing temperatures shall be taken and recorded. Without additional costs to the Government, make all changes and correct any errors for which the Contractor is responsible. The Government Representative may waive or postpone the test if sufficient water is not available. Appropriate changes will then be made to the contract.

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PART 1   GENERAL

1.1   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2011; Errata 2012) Motors and Generators


1.3   RELATED REQUIREMENTS

This section applies to all sections of Division 22 PLUMBING and Division 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.4   QUALITY ASSURANCE

1.4.1   Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2   Alternative Qualifications

Products having less than a two-year field service record will be
acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Government Representative.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Government Representative. Replace damaged or defective items.

1.6 ELECTRICAL REQUIREMENTS

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require
modifications, provide electrical components under Division 26.

1.6.3 High Efficiency Motors

1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.6.4 Three-Phase Motor Protection

Provide controllers for motors rated one horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not Used.
PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

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SECTION 23 11 23

FACILITY NATURAL GAS FUEL PIPING

11/08

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PART 1   GENERAL

1.1   GENERAL REQUIREMENTS

The gas piping system includes natural gas piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein. Provide cathodically protected insulating joints connecting aboveground piping from the meter to the building, with lightning arrestors conforming to API RP 2003, installed where indicated.

1.1.1   Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers and cathodic protection system; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package.

1.1.2   Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package.

1.1.3   Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
AMERICAN GAS ASSOCIATION (AGA)

AGA XR0603  (2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


AMERICAN PETROLEUM INSTITUTE (API)

API 570  (2009, 3rd Ed) Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems

API RP 2003  (2008; 7th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents


API Spec 5CT  (2011; Errata 2012) Specification for Casing and Tubing

API Spec 6D  (2008; Errata 1 2008; Errata 2 2008; Errata 3 2009; Addendum 1 2009; Errata 4 2010; Errata 5 2010; Errata 6 2011; Addendum 2 2011; Addendum 3 2012) Specification for Pipeline Valves

API Std 598  (2009) Valve Inspecting and Testing


AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M  (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)


ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)


ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.3 (2011) Malleable Iron Threaded Fittings, Classes 150 and 300


ASME B31.9 (2011) Building Services Piping

ASME B36.10M (2004; R 2010) Standard for Welded and Seamless Wrought Steel Pipe

ASME B40.100 (2005; R 2010) Pressure Gauges and Gauge Attachments

ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM 01.01 (2013) Steel - Piping, Tubing, Fittings

ASTM A105 (2011a) Standard Specification for Carbon Steel Forgings for Piping Applications

Carbon Steel Forgings, for General-Purpose Piping


ASTM D2513 (2012a; E 2012) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

CSA STANDARDS (CSA)

CGA 3.11-M88 (1988; R 2009) Lever Operated Pressure Lubricated Plug Type Gas Shut-Off Valves


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 58 (2011; TIA 10-1; Errata 10-1; TIA 11-2; TIA 11-3; Errata 11-2; Errata 12-3) Liquefied Petroleum Gas Code

NFPA 70 (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir (2011) Flammable and Combustible Liquids and Gases Equipment Directory
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System; G

SD-03 Product Data

Pipe and Fittings
Gas equipment connectors; G
Gas Piping System; G
Pipe Coating Materials and application procedures
Pressure regulators
Risers
Transition fittings
Valves; G
Valve box; G
Warning and identification tape

SD-06 Test Reports

Testing
Pressure Tests

SD-07 Certificates

Welders procedures and qualifications

SD-08 Manufacturer's Instructions

PE pipe and fittings
pipe coating materials and application procedures

SD-10 Operation and Maintenance Data

Gas facility system and equipment operation
Gas facility system maintenance
Gas facility equipment maintenance

1.5 QUALITY ASSURANCE

Submit manufacturer’s descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.

1.5.1 Welding Qualifications

a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by
another employer may be accepted as permitted by ASME B31.9. Notify the Government Representative at least 24 hours in advance of tests, and perform at the work site if practicable.

b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Government Representative. Weld all structural members in accordance with Section 05 05 23 WELDING, STRUCTURAL, and in conformance with AWS A5.8/A5.8M, and AWS WHB-2.9.

1.5.2 Jointing Thermoplastic and Fiberglass Piping

Perform all jointing of piping using qualified joiners and qualified procedures in accordance with AGA XR0603. Furnish the Government Representative with a copy of qualified procedures and list of and identification symbols of qualified joiners. Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart, including all PE pipe and fittings.

1.5.3 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports.

1.6 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, pipe coating materials and application procedures. Conform to NFPA 54 NFPA 58 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

a. Pipe: Black carbon steel in accordance with ASTM A53, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.


d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.


f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1, with flange faces having integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105. Provide wrought steel butt welding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11 and ASTM A181, Class 60.

2.2.2 Copper Tubing, Joints and Fittings

Provide copper tubing conforming to ASTM B88, Type K or L, or ASTM B280, with tubing joints made up with tubing fittings recommended by the tubing manufacturer. Provide copper and copper alloy press fittings, with sealing elements of Hydrogenated Nitrile Butadiene Rubber (HNBR), factory installed, or an alternative supplied by the fitting manufacturer.

2.2.3 Steel Tubing, Joints and Fittings

Provide steel tubing conforming to ASTM 01.01, and ASTM A513, with tubing joints made up with gas tubing fittings recommended by the tubing manufacturer.

2.2.4 Thermoplastic Pipe, Tubing, Joints, and Fittings

Provide thermoplastic pipe, tubing, casing and joints and fittings conforming to ASTM D2513 and API Spec 5CT.

2.2.5 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL Gas&Oil Dir, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL Gas&Oil Dir.

2.2.6 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.7 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.
2.2.8 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.9 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

2.2.10 Gas Transition Fittings

a. Provide steel to plastic (PE) designed for steel-to-plastic with tapping tee or sleeve conforming to AGA XR0603 requirements for transitions fittings. Coat or wrap exposed steel pipe with heavy plastic coating.

b. Plastic to Plastic: Manufacturer's standard bolt-on (PVC to PE) plastic tapping saddle tee, UL listed for gas service, rated for 100 psig, and O-ring seals. Manufacturer's standard fused tapping (PE-to-PE) tee assembly with shut-off feature.

c. Provide lever operated pressure lubricated plug type gas shut-off valve conforming to CGA 3.11-M88. Provide manually operated shut-off valve conforming to CGA 9.2-M88

2.2.11 Insulating Pipe Joints

2.2.11.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.11.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.11.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.2.12 Flexible Connectors


b. Do not install the flexible connector through the appliance cabinet face. Provide rigid metallic pipe and fittings to extend the final connection beyond the cabinet, except when appliance is provided with an external connection point.

2.3 VALVES

Provide lockable shutoff or service isolation valves as indicated in the
drawings conforming to the following:

2.3.1 Valves 2 Inches and Smaller

Provide valves 2 inches and smaller conforming to ASME B16.33 of materials and manufacture compatible with system materials used.

2.3.2 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150.

2.4 RISERS

Provide manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket or wall-mounted riser supports as indicated on the drawings.

2.5 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58 and MSS SP-69.

2.6 METERING, REGULATORS AND SHUTOFF VALVES


PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Government Representative of any discrepancy or areas of conflict before performing the work.

3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in DIVISION 31 EARTHWORK.

3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery to the connections to each gas utilization device.

3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.
3.3.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.4 PROTECTIVE COVERING

3.4.1 Underground Metallic Pipe

Protect buried metallic piping from corrosion with protective coatings. When dissimilar metals are joined underground, use gastight insulating fittings.

3.4.2 Aboveground Metallic Piping Systems

3.4.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances by power wire brushing and prime with ferrous metal primer or vinyl type wash coat. Finish primed surfaces with two coats of exterior oil paint or vinyl paint.

3.4.2.2 Nonferrous Surfaces

Do not paint nonferrous surfaces.

3.5 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54NFPA 58, AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic and fiberglass pipe in accordance with AGA XR0603.

3.5.1 Metallic Piping Installation

Bury underground piping a minimum of 24 inches below grade. Make changes in direction of piping with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Do not use aluminum alloy pipe in exterior locations or underground.

3.5.2 Metallic Tubing Installation

Install metallic tubing using gas tubing fittings approved by the tubing manufacturer. Make branch connections with tees. Prepare all tubing ends with tools designed for that purpose.
3.5.3 Connections Between Metallic and Plastic Piping

Connections between metallic and plastic piping are only allowed outside, underground, and with approved transition fittings.

3.5.4 Piping Buried Under Buildings

Run underground piping installed beneath buildings in a steel pipe casing protected from corrosion with protective coatings as specified in Section 23 11 23 FACILITY GAS PIPING. Extend casing at least 4 inches outside the building, and provide the pipe with spacers and end bushings to seal at both ends to prevent the entrance of water and/or the escape of gas. Extend a vent line from the annular space above grade outside to a point where gas will not be a hazard, and terminate in a rain/insect-resistant fitting.

3.5.5 Concealed Piping in Buildings

Do not use combinations of fittings (unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints) to conceal piping within buildings.

3.5.5.1 Piping in Partitions

Locate concealed piping in hollow, rather than solid, partitions. Protect tubing passing through walls or partitions against physical damage both during and after construction, and provide appropriate safety markings and labels.

3.5.5.2 Piping in Floors

Lay piping in solid floors except where embedment in concrete is indicated in channels suitably covered to permit access to the piping with minimum damage to the building.

3.5.6 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.

3.5.7 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Flexible connectors may be used for final connections to gas utilization equipment. In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.6 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.
3.6.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.6.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.6.3 Thermoplastic and Fiberglass Joints

a. Thermoplastic and Fiberglass: Conform jointing procedures to AGA XR0603. Do not make joints with solvent cement or heat of fusion between different kinds of plastics.

b. PE Fusion Welding Inspection: Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect, in conformance with API 570, 100 percent of all joints and re-inspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Government Representative to make first time inspection.

3.6.4 Flared Metallic Tubing Joints

Make flared joints in metallic tubing with special tools recommended by the tubing manufacturer. Use flared joints only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Do not use metallic ball sleeve compression-type tubing fittings for tubing joints.

3.6.5 Solder or Brazed Joints

Make all joints in metallic tubing and fittings with materials and procedures recommended by the tubing supplier. Braze joints with material having a melting point above 1000 degrees F, containing no phosphorous.

3.6.6 Press Connections

Make press connections in accordance with manufacturer's installation instructions using tools approved by the manufacturer. Fully insert the tubing into the fitting and then mark at the shoulder of the fitting. Check the fitting alignment against the mark on the tubing to assure the tubing is fully inserted before the joint is pressed.
3.7 PIPE SLEEVES

Provide pipes passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Do not install sleeves in structural members except where indicated or approved. Make all rectangular and square openings as detailed. Extend each sleeve through its respective wall, floor or roof, and cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Extend sleeves in mechanical room floors above grade at least 4 inches above finish floor. Unless otherwise indicated, use sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe. Provide steel pipe for sleeves in bearing walls, waterproofing membrane floors, and wet areas. Provide sleeves in nonbearing walls, floors, or ceilings of steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, seal the annular space between the pipe and sleeve with fire-stopping material and sealant.

3.8 PIPES PENETRATING WATERPROOFING MEMBRANES

Install pipes penetrating waterproofing membranes as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.9 FIRE SEAL

Fire seal all penetrations of fire rated partitions, walls and floors in accordance with Section 07 84 00 FIRESTOPPING.

3.10 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.11 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54NFPA 58.

3.12 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the Government Representative.

3.13 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54NFPA 58. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members is not to exceed the hanger and support spacing required.
for any of the individual pipes in the multiple pipe run. Rigidly connect the clips or clamps to the common base member. Provide a clearance of 1/8 inch between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.14 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building which is electrically continuous and bonded to a grounding electrode as required by NFPA 70.

3.15 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

3.16 CATHODIC PROTECTION

Provide cathodic protection for underground ferrous gas piping as specified in Section 26 42 00.00 12 CATHODIC PROTECTION.

3.17 TESTING

Submit test reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, blow out the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test pressures if necessary, and as directed and or approved by the Government Representative. Do not use oxygen as a testing medium.

3.17.1 Pressure Tests

Submit test reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54as specified in NFPA 58 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

3.17.2 Test With Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. Conform all
testing to the requirements of NFPA 54.NFPA 58. If leakage is recorded, shut off the gas supply, repair the leak, and repeat the tests until all leaks have been stopped.

3.17.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54.NFPA 58 are followed.

3.17.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.18 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 20 00.00 12

PIPING SPECIALTIES

08/08

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2.1   FLEXIBLE COUPLINGS FOR NORMAL TEMPERATURE SERVICE
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SCOPE

The work covered by this Section consists of the Contractor furnishing all plant equipment, labor and materials, and performing all operations in connection with the installation of the piping specialties, appurtenant items, and accessories in accordance with these specifications and as shown on the drawings.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

ASTM INTERNATIONAL (ASTM)


1.4  SYSTEM PERFORMANCE

Items described herein shall be furnished, if possible or as noted, in the same material as the piping adjacent thereto. If coatings, linings, or special materials are specified for the adjacent piping, the special fitting may require special ordering to make the fitting meet or exceed the corrosion resistive properties of the pipe.

1.5  FIELD MEASUREMENT AND COORDINATION

The Contractor shall make measurements and study piping layouts and manufacturer's information to complete the installation with actual final field conditions. Plans were prepared with available manufacturer's information on particular pieces of equipment, and equipment improvements or substitutions may change configurations of adjacent items and structural requirements.

PART 2   PRODUCTS

2.1  FLEXIBLE COUPLINGS FOR NORMAL TEMPERATURE SERVICE

Flexible coupling shall be the terminology for a coupling capable of absorbing vibration and angular movement along the longitudinal axis of 3/8 inch for all pipe sizes above 10 inches. This coupling shall conform to ASTM F1476, Type II, Class 3. Gasketed mechanical coupling shall be Dresser Style 38, Teekay Axiflex, or an approved equal. The flexible coupling supplied shall be produced only by manufacturers capable of showing evidence of at least 30 years of experience in the design and successful performance of expansion joints of the size and type specified, and have proven capability of supplying expansion joints up to 120 inches
2.1.1 Flexible Couplings

Flexible couplings for use where noted and/or specified shall be of a gasketed, sleeve type, with diameter to properly fit the pipe. Each coupling shall consist of one (1) steel middle ring, of thickness and length specified, two (2) steel followers, two (2) rubber-compounded wedge section gaskets and sufficient track-head steel bolts to properly compress the gaskets.

(1) The middle ring and followers of the coupling shall be true circular sections free from irregularities, flat spots, or surface defects. They shall be formed from mill sections with the follower-ring section of such design as to provide confinement of the gasket. After welding, they shall be tested by cold expanding a minimum of 1% beyond the yield point.

(2) The coupling bolts shall be of the elliptic-neck, track-head design with rolled threads. Bolts shall be 316 Stainless Steel for pipes 12 inches and under, and high strength galvanized steel for larger sizes, and provided with heavy hex nuts. Galvanized bolts and nuts shall be painted in accordance with Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES. After installation, any bruised or damaged coatings to the threaded surfaces shall be painted/repainted. The recommended torque to which the bolts shall be tightened shall be acquired from the manufacturer. All bolt holes in the followers shall be oval for greater strength.

(3) The gaskets of the coupling shall be composed of a synthetic rubber base compounded with other products to produce a material which will not deteriorate from age, from heat, or exposure to air under normal storage conditions. It shall also possess the quality of resilience and ability to resist cold flow of the material so that the joint will remain sealed and tight indefinitely when subjected to shock, vibration, pulsation and temperature or other adjustments of the pipe line.

(4) The couplings shall be assembled on the job in a manner to insure permanently tight joints under all design conditions of expansion, contraction, shifting and settlement, unavoidable variations in trench gradient, etc. This coupling shall conform to ASTM F1476, Type II, Class 3. Gasketed mechanical coupling shall be Dresser Style 38, Teekay Axiflex, or an approved equal.

(5) Where these couplings are used, steel pipe ends furnished for use with the couplings shall be plain end pipe in accordance with AWWA specifications on tolerances. Welds and other surface irregularities shall be ground smooth so that the pipe is sufficiently free from indentations, projections, or roll marks for a distance of 8 inches from the end of the pipe to make a tight joint with the rubber-gasket type of coupling. The outside diameter of the pipe shall not be more than 1/32 inch smaller than the nominal outside diameter for a distance of 8 inches from the end of the pipe and shall permit the passing for a distance of 8 inches of a ring gauge which has a bore 3/32 inch larger than the nominal outside diameter of the pipe. The minimum outside pipe diameter shall be determined by the use of a steel tape circumferentially applied to prevent the shipment of undersize, out-of-round pipe which, if measured diametrically through
the maximum diameter or checked with a No-Go ring gauge, might appear within the specified tolerance.

(6) Each flexible coupling shall be provided with a joint harness set consisting of tie-bolts extending across the "crow foot" lugs welded to the pipe on both sides of the joint. The lugs shall be located so that the tie bolts are on diametrically opposite sides of the pipe, 60 degrees above and below the pipe spring line. The joint harness tie-bolts shall have a minimum yield strength of 80,000 psi and an ultimate strength of 115,000 psi. There shall be a minimum of 4 inches - 1.5 inches diameter rods for each joint.

(7) The coupled joint shall be capable of withstanding a working pressure of 100 psi.

PART 3 EXECUTION

NOT USED

-- End of Section --
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SECTION 23 34 23
POWER VENTILATORS
02/11

PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 SYSTEM DESCRIPTION

Provide power roof ventilators complete with all components and accessory equipment as specified in this section and as shown on plans.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10 (2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A653 (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


UNDERWRITERS LABORATORIES (UL)


1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Submit Shop Drawings for power roof ventilator systems
Submit Installation Drawings for power roof ventilator systems
Submit Record Drawings for power roof ventilators in accordance with paragraph entitled, "General Requirements" of this section.

SD-03 Product Data
Submit Equipment and Performance Data; G
Submit Manufacturer's Catalog Data

Housing
Fan
Motor
Bases
Roof Curbs
Dampers
Screens
Sound Baffles

SD-06 Test Reports

Tests

1.5 GENERAL REQUIREMENTS

Section 26 60 13.00 40 LOW-VOLTAGE MOTORS applies to this section.

Submit manufacturer's catalog data, including equipment and performance data for power roof ventilator(s). As a minimum, include the following data:

a. Fan Type

b. Fan Specifications, including:

   (1) Number of rotating fan blades/vanes

   (2) Number of stationary fan blades/vanes

   (3) Rotating Speed(s)

   (4) Number of belts (if belt driven)

   (5) Belt Lengths- measured at the pitch line (if belt driven)

   (6) Diameter of the drive sheave at the drive pitch line (if belt driven)

   (7) Diameter of the driven sheave at the drive pitch line (if belt driven)
c. Location of Installation

d. Identification Number

e. Date of Installation

f. Applicable reference drawing number(s)

1.6 QUALITY ASSURANCE

Rate and label ventilators in accordance with the applicable standards of the Air Movement Control Association, and license to bear the AMCA seal for both air and sound.

PART 2 PRODUCTS

2.1 DESIGN AND FABRICATION REQUIREMENTS

Provide roof ventilators that comply with UL 705 and are furnished complete with bases, curbs, flashing flanges, noise baffles, dampers, damper controls, louvers, and screens as indicated.

Provide ventilators that are designed for windloads in accordance with ASCE 7-10 with the installed design not less than 130 miles per hour windload. Provide structural bracing that is properly spaced to accommodate this loading and in accordance with the design requirements of the covering material. Provide ventilators that are adequately reinforced and well braced with joints properly formed. Provide edges that are wired or beaded where necessary to ensure rigidity. Prevent galvanic action between different metals in direct contact by nonconductive separators. Make all soldering even and smooth.

Provide corrosion-resistant steel bolts, rivets, and other fastenings used in connection with protected metal.

2.2 HOUSING STYLE(S)

Provide power roof ventilator as indicated on the drawings.

2.3 FAN TYPE(S)

Provide fan of the following type(s):

2.3.1 Type C-PRV Centrifugal, Direct Drive

For Type C-PRV ventilator, provide a centrifugal roof ventilator with direct drive, nonoverloading, backward-inclined wheel. Provide vibration isolated drive with elastomer. Provide drive components that are mounted in a compartment isolated from airstream.

2.3.2 Type CB-PRV Centrifugal, V-Belt Drive

For Type CB-PRV ventilator provide a centrifugal roof ventilator with V-belt drive, nonoverloading, backward-inclined wheel. Provide vibration isolated drive with elastomer. Provide drive components that are mounted in a compartment isolated from airstream.
2.3.3 Type P-PRV Propeller, Direct Drive

For Type P-PRV ventilator, provide a propeller roof ventilator with direct drive that is vibration isolated with elastomer. Provide drive components that are mounted in a compartment isolated from airstream.

2.3.4 Type PB-PRV Propeller, V-Belt Drive

For Type PB-PRV ventilator, provide a propeller roof ventilator with V-belt drive that is vibration isolated with elastomer. Provide drive components that are mounted in a compartment isolated from airstream.

2.3.5 Type VA-PRV Vane Axial, Direct Drive

For Type VA-PRV ventilator, provide a vane axial roof ventilator with direct drive that is vibration isolated with elastomer.

2.3.6 Type VAB-PRV Vane Axial, V-Belt Drive

For Type VAB-PRV ventilator, provide a vane axial roof ventilator with V-belt drive that is vibration isolated with elastomer.

2.3.7 Type TA-PRV Tube Axial, Direct Drive

For Type TA-PRV ventilator, provide a tube axial roof ventilator with direct drive that is vibration isolated with elastomer.

2.3.8 Type TAV-PRV Tube Axial, V-Belt Drive

For Type TAV-PRV ventilator, provide a tube axial roof ventilator with V-belt drive that is vibration isolated with elastomer.

2.4 MATERIALS

Provide manufacturers' standard materials.

2.4.1 Aluminum Alloy

Provide aluminum alloy in accordance with ASTM B209 and ASTM B37.

2.4.2 Zinc-Coated Steel

Provide zinc-coated steel in accordance with ASTM A653.

2.4.3 Fibrous Glass

Provide fibrous glass ventilators that are molded from a glass-fiber reinforced polyester resin with a pigmented polyester resin gel coat in manufacturer's standard color, and that are not less than .02 and .06 inch thick. Provide matrix material that is not less than 30 percent, by weight, of chopped-fiber and random-strand glass fibers, and that is thoroughly saturated and impregnated with not more than 70 percent high-solids polyester resin with not less than 5 percent antimony trioxide fire-retardant additive. Provide material that is smooth, dense, and uniform in texture, color, and cross section and that is shatter-resistant, rigid, and free from visual defects, foreign inclusions, cracks, crazing, die lines, pinholes, striations, unsaturated and resin-poor areas, and excessive-resin areas.
2.5 FAN MOTOR

For belt drive motors smaller than 1/2 horsepower, provide single-phase, 120 volts, 60 hertz with permanently lubricated ball bearings and provide split-phase type.

For motors 1/2 horsepower and larger, provide three-phase, 460 volts, 60 hertz.

Provide motors with local disconnects to provide means for fan and motor maintenance. Provide all motors with thermal overload protection. For motors located in airstreams, provide totally enclosed type.

For direct drive motors 1/2 horsepower and smaller, provide the energy efficient permanent split capacitor type, single phase, 60 hertz.

2.6 BASES

For bases provided with the ventilators, provide factory formed, of the type indicated, of the same material as the hoods, and the thickness necessary to meet the design requirement for connection to the roof.

Provide bases that are suitable for raised curb mounting where indicated. Form curb flanges of the base as cap flashing extending at least 2 inches over roofing base. Where indicated or required, extend shafts of ventilators a sufficient distance through the supporting construction to permit attachment of vent ducts.

2.7 ROOF CURBS

Provide factory-formed metal ventilator curbs of the type and design required for the ventilator and suitable for roof configuration and flashing.

Provide job-built curbs that conform to the recommendations of the ventilator manufacturer, sized correctly for the ventilator, and suitable for type of supporting roof construction.

2.8 BACK-DRAFT DAMPERS

Provide gravity operated back-draft dampers with adjustable counterweight of the same material as fan housing.

2.9 SCREENS

Provide bird screens with frames of the same material as that used in the ventilators and securely attach in a manner that permits easy removal for access and cleaning.

2.10 SOUND BAFFLES

Provide permanent construction sound baffles that are impervious to moisture. Provide removable baffles.

PART 3 EXECUTION

3.1 INSTALLATION

Install power roof ventilators in accordance with manufacturer's
installation instructions. Properly coordinate installation of ventilators with other work. Coordinate anchors, attachments, and other items to be built, for installation as the work progresses. Rigidly install ventilators in a weathertight and watertight manner free from vibration.

Submit installation drawings for power roof ventilator in accordance with referenced standards in this section.

3.2 TESTS

After installation, test each power roof ventilator to demonstrate proper operation at indicated and specified performance requirements including running, balance, noise, and proper direction of fan rotation.

3.2.1 Vibration Analyzer

Use an FFT analyzer to measure vibration levels. The following characteristics are required: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz (300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

Use either stud-mounted accelerometer or mount using a rare earth, low mass magnet and sound disk (or finished surface) with the FFT analyzer to collect data. Provide accelerometer with mass and mounting that minimally influence the frequency response of the system over the selected measurement range.

3.3 ACCEPTANCE

Prior to final acceptance, use precision alignment devices to demonstrate that fan and motor are aligned as specified.

Prior to final acceptance, verify conformance to specifications with vibration analysis. Provide vibration levels that are not more than .075 in/sec at 1 times run speed and at fan/blade frequency, and .04 in/sec at other multiples of run speed.

3.4 LUBRICATION

Provide movable parts of dampers and related operating hardware that are lubricated in accordance with manufacturer's printed instructions and that operate smoothly and quietly without binding.

3.5 FINAL TEST REPORTS

Provide final test reports to the Government Representative. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

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DIVISION 26 - ELECTRICAL

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

07/06

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3.2 FIELD FABRICATED NAMEPLATE MOUNTING
3.3 WARNING SIGN MOUNTING

-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
ASTM D709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2011; Errata 2 2012) National Electrical Code

1.2  RELATED REQUIREMENTS

This section applies to certain sections of Division 02, EXISTING CONDITIONS, Division 13, SPECIAL CONSTRUCTION, and Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 51 00 INTERIOR LIGHTING
Section 26 56 00 EXTERIOR LIGHTING
Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION
1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 13 kV primary, three phase, four wire, 60 Hz, and 480 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing substation shall be made by the Contractor as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.
1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.
1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified.
PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

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COMMON WORK RESULTS FOR ELECTRICAL

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PART 1   GENERAL

1.1   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2001; R 2007) Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480 (1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


INTERNATIONAL CODE COUNCIL (ICC)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


ANSI/NEMA OS 1 (2008; Amd 2010) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)

NEMA PB 1 (2011) Panelboards

NEMA RN 1 (2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit


NEMA VE 1 (2009) Standard for Metal Cable Tray Systems

NEMA WD 1 (1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices

NEMA WD 6 (2002; R 2008) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; Reprint Jul 2012) Standard for Flexible Metal Conduit

UL 1242 (2006; Reprint Jul 2012) Standard for Electrical Intermediate Metal Conduit -- Steel

UL 489 (2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 506 (2008; Reprint Oct 2012) Specialty Transformers

UL 6 (2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel

UL 797 (2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel

UL 870 (2008; Reprint Feb 2013) Standard for Wireways, Auxiliary Gutters, and Associated Fittings
1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 135 mph wind loading.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceways and Fittings
Wire and Cable
Splices and Connectors
Switches
Receptacles
Outlets, Outlet Boxes, and Pull Boxes
Circuit Breakers
Panelboards
Lamps and Lighting Fixtures
Dry-Type Distribution Transformers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceways and Fittings
Wire and Cable
Splices and Connectors
Switches
Receptacles
Outlets, Outlet Boxes, and Pull Boxes
Circuit Breakers
Panelboards
Lamps and Lighting Fixtures
Dry-Type Distribution Transformers
Spare Parts
Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports
Continuity Test
Phase-Rotation Tests
Insulation Resistance Test

SD-08 Manufacturer's Instructions
Submit Manufacturer's Instructions.

1.5 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.6 GENERAL REQUIREMENTS

Submit material, equipment, and fixture lists for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.
Submit certification required to install equipment components and system packages.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal
dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

PART 2   PRODUCTS

2.1   MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1   Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2   Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3   Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel. Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4   Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 and be galvanized.
2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to UL 870.

2.1.7 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.1.8 Cable Trays

Provide ladder type cable trays conforming to NEMA VE 1.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be stranded.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved indentor crimp-type connectors and compression tools.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.
2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, single-pole, three-way two-position devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

Lighting and appliance branch circuit panelboards shall be the circuit-breaker type in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not acceptable. Buses shall be copper of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Panelboard enclosures shall be NEMA 250, Type 1, in accordance with NEMA PB 1. Provide enclosure fronts with latchable hinged doors.

2.8 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 20,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.9 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 120-volt operation as indicated and be rapid-start fluorescent. Ballasts shall be "A" sound rated. Fluorescent lamps shall be standard reduced wattage type.

High intensity discharge (HID) lighting fixtures shall have prewired
integral ballasts and cast aluminum housings complete with tempered glass lenses suitable for installation in damp or wet locations. Provide fixtures and lamps.

2.10 DRY-TYPE DISTRIBUTION TRANSFORMERS

General purpose dry-type transformers with windings 600 volts or less shall be two-winding, 60 hertz, self-cooled in accordance with UL 506. Windings shall have a minimum of two 2-1/2-percent taps above and below nominal voltage.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily
locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.1.6 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 5-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 30 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.1.8 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing shall be 6 feet. Trays 10-inches wide or less shall be supported by one hanger. Trays greater than 10-inches wide shall be supported by two hangers. Bond cable trays at splices.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

<table>
<thead>
<tr>
<th>CONDUCTOR</th>
<th>COLOR AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
</tr>
</tbody>
</table>

SECTION 26 05 00.00 40  Page 12
**CONDUCTOR** | **COLOR AC**
--- | ---
Equipment Grounds | Green

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

### 3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

### 3.4 WIRING DEVICES

#### 3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

#### 3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

### 3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the...
Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>MOUNTING HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptacles in offices</td>
<td>18 inches</td>
</tr>
<tr>
<td>Receptacles in corridors</td>
<td>18 inches</td>
</tr>
<tr>
<td>Receptacles in shops and laboratories</td>
<td>48 inches</td>
</tr>
<tr>
<td>Receptacles in rest rooms</td>
<td>48 inches</td>
</tr>
<tr>
<td>Switches for light control</td>
<td>48 inches</td>
</tr>
</tbody>
</table>

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

3.7 PANELBOARDS

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36 inches of the front of the panel. Directory card information shall be complete and legible.

3.8 DRY-TYPE DISTRIBUTION TRANSFORMERS

Connect dry-type transformers with flexible metallic conduit.

3.9 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.10 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00 PAINTS AND COATINGS or Section 09 96 00 HIGH-PERFORMANCE COATINGS.

3.11 FIELD TESTING

Submit Test Reports in accordance with referenced standards in this section.
After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --
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LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
5/08/2009

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1.3   DEFINITIONS
1.4   REFERENCES
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1.6   RELATED REQUIREMENTS
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SUMMARY

This specification will provide guidance to the procurement and installation of Low-Voltage Electrical Power Conductors and Cables. This specification will list requirements for installation, testing, and commissioning but may be further detailed in other specifications referenced herein.

This specification along with applicable design drawings will govern installation requirements. The Contractor shall notify the Government Representative of any discrepancies between the design drawings, this specification, or other referenced specifications.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  DEFINITIONS

A. Low-Voltage Power and Control - All cables rated 600 volts and below.

B. Certificate of Compliance - A document provided with every production order providing generic information regarding standards met and containing the manufacturer's name and the signature of the testing engineer.

C. CPSE - Chlorosulfonated Polyethylene - A synthetic rubber jacketing compound based on a polymer manufactured by DuPont under trade name of Hypalon.

D. Circular Mil - A unit of area equal to the area of a conductor whose diameter is 1 mil (0.001 inch). Used chiefly in specifying cross-sectional areas of round conductors.

E. Cross Linking - The establishment of chemical bonds between polymer molecule chains. It may be accomplished by heat, vulcanization, irradiation, or the addition of a suitable chemical agent.

F. EPR - Ethylene Propylene Rubber - A synthetic rubber insulation based upon ethylene propylene hydrocarbon.

G. Jacket - A material covering over a wire insulation or an assembly of components, usually an extruded plastic or elastomer.

H. Low Halogen - Containing only trace quantities of halogen products, or less than 0.5 percent halogens per volume of material.

I. Mil - Unit of measure equal to 1/1000 of an inch.

J. Polyethylene - A thermoplastic material composed of polymers of ethylene.
K. Polyolefin - A polymer which is polymerized from repeating ethylene monomers.

L. PVC - Polyvinyl Chloride - A halogenated thermoplastic used in jacketing material.

M. Thermoset - A plastic that, after having been cured by heat or other means, is substantially infusible and insoluble (definition from ASTM D883).

N. Thermoplastic - A classification of resin that can be readily softened and reformed by heating and rehardened by cooling.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM D883 (2011) Terminology Relating to Plastics

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA T-33-655 (1994) Low-Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

National Conference of Standards Laboratories

NCSL Z540.3 (2006) Requirements for the Calibration of Measuring and Test Equipment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 26 (2008) Binational Wire and Cable Packaging Standard


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1277 (2001) Standard for Safety Electrical Power and Control Tray Cables with
Optional Optical-Fiber Members

UL 1685 (2007) UL Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

UL 44 (2010) Thermoset-Insulated Wires and Cables

1.5 WORK INCLUDED

A. The Contractor shall provide and install wire and cable for power and control operating at 600 volts in accordance with the contract specifications and drawings.

B. The Contractor shall provide all labor, tools, and appurtenances for wire and cable installations and testing.

1.6 RELATED REQUIREMENTS

Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS applies to this section, with the additions and modifications specified herein.

1.7 DATA TO BE SUBMITTED

1.7.1 Information to be Submitted by Bidder

A. Submit with each copy of the bid, complete information regarding the proposed cable (wire), including type designation with both generic and trade name of the insulation and jacket. All components shall be identified. If previous testing is required and used to satisfy the requirements of the bid, a copy of that test data shall be submitted.

B. Submit a detailed listing of all exceptions to this specification and the basis for each. Proposed exceptions to this specification must be approved in writing by the Government Representative prior to contract award.

1.8 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's specifications to indicate compliance with the specified requirements

1.9 DELIVERY AND STORAGE

1.9.1 Preparation

The Contractor shall be responsible for the preparation of all articles for shipment in such a manner as to facilitate handling and to protect them against weather, contamination, rust, and mechanical damage in transit; and Contractor shall be responsible for and make good any and all damage occurring during shipment.
1.9.2 Packing, Marking, Storage, and Acceptable Lengths

A. The material shall be packed and sealed in accordance with NEMA WC 26. As a minimum, a level 2 protective covering shall be used on the cable reel. A minimum length of 2 inches of the cable ends shall be sealed, to prevent moisture intrusion, with a suitable industrial grade dip seal or cap plug. The seal shall be securely fastened so as not to become loose in transit.

B. Both flanges of the reels shall also be tagged or plainly stamped (preferably painted stencil) with the following: contact number, item number, reel number, length shipped on reel, number and size of conductor, voltage rating, compound type, year of manufacture, name of manufacturer (plus manufacturer's code if customary), and shipping weight of reel. All tags shall be plastic or metal (steel or aluminum, not aluminum/mylar) or laminated paper (mylar covered printed tag) and shall be fastened securely to the reel.

C. Each reel or spool shall have and appropriate diameter for the respective wire size. No reel shall exceed 6 feet in diameter. If continuous length requirements are put in place, a reel larger than 6 feet may be approved by the Government Representative. Minimum drum diameters shall be in accordance with NEMA WC 26. In no case shall the barrel of the reel or spool have a diameter less than 50 times the nominal diameter of a single wire for wire sizes 24 AWG through 14 AWG; 40 times for 12 AWG and 10 AWG; 30 times for 8 AWG and larger, or less than 4 inches, whichever is larger.

D. The reels and packaging must be suitable for exposure to an outdoor environment for at least two years.

E. More than one length of cable per reel is not acceptable.

PART 2 PRODUCTS

2.1 CABLE - GENERAL

A. This specification shall be used for the procurement of single and multiconductor cable plus shielded or unshielded instrumentation cable insulated with flame-retardant crosslinked polyethylene, cross-linked polyolefin, or ethylene-propylene rubber and jacketed with chlorosulfonated polyethylene (CSPE), heavy-duty moisture-resistant, flame-retardant, low-smoke, low-halogen polyolefin compound, either thermosetting or thermoplastic.

B. The cables shall be rated at 600V dc at 60Hz between conductors.

C. The cables be for use in auxiliary power, control, instrumentation, and lighting circuits at conductor temperatures not exceeding 90 degrees C and must be UL listed as 90 degrees C wet and dry per NFPA 70 section 310.13.

D. All cables shall be suitable for installation in wet or dry locations in conduits, in underground ducts, or on cable trays.

E. All cables shall be heat, oil, sunlight, moisture, and abrasion resistant.
2.2 DETAILED REQUIREMENTS

2.2.1 Conductors

A. All conductors shall be made of soft or annealed copper meeting the applicable requirements of ASTM B8 with Class B stranding.

B. Splicing of conductors or strands of a conductor following the manufacture of the conductor is prohibited unless specifically agreed to by the Government Representative.

2.2.2 Insulation

A. The insulation shall consist of flame-retardant, thermosetting, cross-linked polyethylene (FRXLPE), or flame-retardant ethylene-propylene rubber Type II (FREPR), or flame-retardant cross-linked thermosetting, low-smoke zero-halogen polyolefin (LSZH-XLPO). The insulated conductors must be spark tested (AC) at the voltages stated in NEMA WC 70.

B. In-plant repairs of the insulation are prohibited.

C. This insulation shall be applied concentrically around the conductor with the minimum thickness at any point being not less than 90 percent of the minimum average thickness specified in the applicable standard.

D. The insulation shall be free stripping from the conductor. A nonhygroscopic tape over the conductor may be used to meet this requirement. Stripping of the insulation shall produce a conductor that is generally bright, unoxidized, and free of insulation residue.

E. The nominal insulation thickness shall conform to UL 44, section 15. It may also be an approved thickness by UL for the rated voltage and use in wet or dry locations, specifically tested by UL and documented by the manufacturer's UL Engineering files.

F. Color coding for the insulation on control cables and fire protection cables shall be according to NEMA WC 57.

2.2.3 Cable Requirements

A. Cable shall meet requirements of UL 44 and UL 1277 and be listed as NFPA 70 TC tray cable.

B. All multiconductor cables shall be assembled helically in accordance with UL 1277 section 10 and NEMA WC 57 Part 5.

C. Instrumentation cables shall be assembled in accordance with NEMA WC 57.

D. Fillers, when used, shall be of nonhygroscopic material with self-extinguishing properties and shall meet the requirements of NEMA WC 57 section 3.6.

E. Cable designated as low-smoke or limited smoke cable shall be UL listed as "LS" per UL 1685 and shall have insulations, fillers, and jackets that have a maximum acid gas generation of 14 percent by weight.

2.2.4 Shields

A. When shielding is required over single wires, component groups or the
overall cable core, or both, the shielding shall be metal laminate tape. The tape shall be 1/5 mils thick (Nominal), and be helically or longitudinally wrapped and shall consist of a laminate of aluminum/polyester or copper foil. It shall be in direct contact with a tinned copper drain wire.

B. The drain wire shall be flexible strand tin-coated and shall not be less than two wire gauges smaller than circuit conductor.

2.2.5 Jackets

A. Outer jackets shall be concentrically and evenly applied. The outside surface shall be smooth and free of irregularities. The outer jacket material shall be as follows:

Heavy-duty moisture-resistant, flame-retardant, low-smoke, low-halogen thermosetting polyolefin (XLPO-LSZH) or moisture-resistant, flame-retardant low-smoke, low-halogen thermoplastic polyolefin meeting the performance criteria of ICEA T-33-655, section 5.4.

B. The jacket material shall meet the test requirements of section 2.3 of this specification and shall be freestripping. The outer jacket thickness of single conductor cables shall meet the requirements of NEMA WC 70 Table 4-2 except in no case shall the thickness be less than 30 mils. The outer jacket of multiconductor cables shall meet the requirements of NEMA WC 70 Table 4-3 as applicable. The nominal calculated core diameter shall govern when manufacturing tolerances create a conflict about the proper diameter to follow. The thickness of the overall jacket may also be an approved thickness by UL for the rated application and listed for installation in wet or dry locations. It must be specifically tested by UL and documented in the manufacturer's UL Engineering files.

C. The color of the outer jacket shall be black.

D. In-plant repairs to the jackets are prohibited.

E. All other covering of all cables shall have the following printing at a maximum of 2-foot intervals:

1. Manufacturer's name (and Manufacturer's Code Number if applicable)
2. Size and number of conductors
3. Cable type (compound type)
4. Voltage rating and temperature
5. Year of manufacture
6. UL type TC designation

PART 3 EXECUTION

3.1 INSTALLATION

A. The Contractor shall perform the preliminary tests on the wire and cable in accordance with paragraph "TESTING" before the installation starts.
B. No splices of wire or cable are allowed in conduit or ducts.

C. The Contractor shall pull all cables contained in one conduit or duct simultaneously.

D. The Contractor shall provide proper equipment to ensure feeding of cables into conduit or ducts with zero tension and without crossovers at the feed point.

E. The Contractor shall apply a UL listed cable lubricant continuously during wire or cable pulling.

F. The Contractor shall bend cable into final position and terminate. Conduit benders shall not be used to bend cable.

G. The Contractor shall ensure that, when basket grips are used, sufficient slack shall be pulled to remove at least one foot of cable beyond the inside end of the grip.

H. The Contractor shall take care so that the overall radius of the sheave arrangement does not violate any of the criteria for minimum bending radius when sheaves are used at the feeding point.

I. When pulling into aluminum conduit and PVC ducts, the Contractor shall not use metallic pulling line.

J. For power pulls, the Contractor shall use a calibrated dynamometer (ref. NCSL 2540.3) to measure the pulling tension. The Contractor shall not exceed a tension of 8 pounds per 1000 circular mils of total conductor cross sectional area or 80 percent of that value for multiconductor cables with more than 5 conductors.

K. The Contractor shall tag cables per Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

L. The Contractor shall not use wire nuts for terminations of conductor and/or splices.

M. The Contractor shall check 100 percent of all wire connections for tightness in accordance with manufacturer's standards.

3.2 FIELD QUALITY CONTROL

The Contractor's Quality Control Inspector shall perform and report visual inspection on all work defined or restricted by this specification in accordance with the Contractor's Government approved Quality Control Plan.

3.2.1 Tests

A. Perform a preliminary test on wire and cable before it is removed from the shipping reel. Whenever the insulation resistance of any wire or cable is determined to be less than 50 megohms, determine the cause and remove any damaged wire or cable.

Use a 1000 volt DC megger for testing the wire and cable.

B. Perform an insulation resistance and continuity test on each conductor after the wire and/or cable is installed and before the final terminations are completed.
1. Perform tests to assure the continuity of each conductor/circuit. Continuity can be established with zero megohms when tested with a megger, calculated DC resistance based upon the length of the conductor when tested with an ohm-meter or audible sound when tested with a continuity tester.

2. Use a 1000 volt DC megger on each wire to determine the insulation resistance. The minimum acceptable insulation resistance is 50 megohms.

3. Remove and replace any wire or cable that does not have an insulation resistance equal to or greater than 50 megohms.

C. Submit the data determined in the wire and cable insulation resistance tests.

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DIVISION 26 - ELECTRICAL

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

5/08/2009

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-- End of Section Table of Contents --
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS
5/08/2009

PART 1 GENERAL

1.1 SUMMARY

This specification will provide guidance to the Identification Requirements for Electrical Systems. This specification will list Electrical Identification requirements but may be further detailed in other specifications referenced herein.

This specification along with applicable design drawings will govern installation requirements. The contractor shall notify the Government Representative of any discrepancies between the design drawings, this specification, or other referenced specifications.

Provide and install permanent identification markings or nameplates for all electrical equipment.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 RELATED WORK

Documents affecting work of this specification section include the other sections of the contract documents.

PART 2 PRODUCTS

2.1 MATERIALS

A. Equipment and Component Nameplates.

1. Furnish engraved laminated plastic nameplates on indoor mounted equipment with black lettering on white background.

   Fire alarm system component nameplates are to be white lettering on a red background.

2. Furnish corrosion resistant metal nameplates on outdoor mounted equipment.

3. Arrange letters in one or two rows. Lettering is preferred at 3/8 inch high or 3/16 inch high. When space is limited, a reduction to 1/8 inch lettering is permitted.

4. Provide nameplates 1-1/2 inches high by 5 inches wide if 3/8 inch high letters are used and 1 inch high by 3 inches wide if 3/16 inch high letters are used. For small items and components (push buttons, switches, relays, etc.) smaller nameplates may be used.

B. Cable Nametags
1. Provide nylon cable tie type nametags and cable ties for use indoors and in dry locations.

2. Provide stainless steel nametags for outdoor use and in wet locations 3/4 inch wide by length as required, 18 gauge, stamped with 3/16 inch high letters and numbers.

C. Conduit Nametags

1. Provide stainless steel nametags for indoor and outdoor, use 3/4 inch wide by length as required, 18 gauge, stamped with 3/16 inch high letters and numbers.

D. Conductor Marking

1. Supply one-piece marker for each end of conductors with marking as shown on drawings or as required by other sections of these specifications.

2. Supply heat shrink sleeve markers sized to fit tightly over the insulation on the conductors.

3. Mark each conductor identification on marker by machine printing or stamping using permanent ink. Typewriter may be used if approved by marker manufacturer and if the resultant markings are permanent.

E. Cable Tray Identification

1. Provide stainless steel nametags with embossed lettering.

2. Supply stainless steel tag holders suitable for horizontal or vertical mounts on smooth tray surfaces.

3. Provide tags at least 1-1/2 inches wide and of sufficient length to accommodate required nomenclature.

4. Install nametags at tray beginning, ending and every 100 linear feet of straight runs.

F. Instrument Identification

1. Instruments shall have a permanently attached 316 stainless steel tag engraved with tag number, manufacturer, model number and type of instrument.

2. Tag shall be attached using stainless steel wire.

3. For all new instruments, switches, IA Boxes, etc. installed for the new Physical Security System at the new Electrical Substation, provide a permanently attached 316 stainless steel tag.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install a nameplate on transformers, switchgear, fire alarm system, motor control centers and other equipment such as each remote motor starter, motor operated valve, electro-hydraulic operated valve, push
button station, pilot light, alarm bell, distribution panelboard, lighting panelboard, power and lighting distribution transformers and control device.

1. Where practical, attach nameplates to equipment with two self-tapping stainless steel screws in holes drilled in the equipment.

2. Use a permanent adhesive where installation of screws is not practical, such as for small nameplates or where equipment cannot be drilled. Prepare the surface according to the adhesive manufacturer's recommendations insuring that:
   a. A good adhesive surface is achieved by cleaning the surface and removing any foreign material from the equipment to be tagged.
   b. Area of nameplate attachment is wiped clean with solvent approved by the adhesive manufacturer.
   c. Area of nameplate attachment is dry prior to affixing nameplate.

3. Where installation of a nameplate is not practical, use stainless steel wire and/or banding to attach nametags.

4. The Contractor shall mount nameplate at mounting support of frequently removable devices such as gate switches, in such a position that the nameplate remains when the device is removed.

B. Install a cable nametag on each end of cables. Identify cables with nametags before they go underground or enter conduit sleeves.

C. Attach nylon nametags with cable ties.

D. Install a nametag on each end of a conduit, at the origination point and as near the termination end as is practical.

E. Attach stainless steel nametag with stainless steel wire.

F. Install conductor markers according to the recommendations of the marker manufacturer.

G. Attach instrument tags with stainless steel wire or banding.

-- End of Section --
PART 1 GENERAL

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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C78.23 (1995; R 2003) American National Standard for Incandescent Lamps - Miscellaneous Types

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA AB 3 (2013) Molded Case Circuit Breakers and Their Application

NEMA FU 1 (2002; R 2007) Low Voltage Cartridge Fuses


NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6 (1993; R 2011) Enclosures
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Fuses; G

SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices; G
Protective Devices; G

SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control; G
Enclosures; G
Circuit Breakers; G
Control Devices; G
Indicating Lights
SD-07 Certificates
Submit certificates for Circuit Tests on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include dielectric tests.

SD-08 Manufacturer's Instructions
Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices
Protective Devices

SD-10 Operation and Maintenance Data
Submit Operation and Maintenance Manuals for the following equipment:

Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers

1.4 GENERAL REQUIREMENTS
Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS
2.1 MOTOR CONTROL
Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Magnetic Motor Controllers

2.1.1.1 Full-Voltage Controllers
Provide full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508 for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor
control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of melting-alloy bimetallic nonadjustable type with continuous current ratings and service-limit current ratings, and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with NEMA 250.

2.1.1.2 Reduced-Voltage Starters

Conform to the requirements for full-voltage controllers for reduced-voltage starters, except for voltage, and to the following additional requirements.

Fully protect the motor during all phases of motor starting with an overload device in each motor leg. Rate starter contacts to withstand the switching surges during selector to full voltage. Provide starter that contains the necessary sensing and timing devices to monitor motor operation and select the correct time for selector to full voltage.

Adequately ventilate resistors and autotransformers used for starting. Ventilate solid-state starters for starting cycles as well as any follow-on restart-run cycles. Operate external control circuits or solid-state starters at a maximum of 120 volts ac.

For solid-state starters, provide adjustable starting torque from 0 to 50 percent of applied voltage, minimum. Provide autotransformer starters with a minimum of three taps above 50 percent reduced voltage.

2.1.2 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:
Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

2.1.2.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.2.2 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the forward and reverse running connection of the motor controller.

Provide rating of three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed inside, clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance
of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Contain equipment installed in industrial locations in a NEMA Type 12 industrial use, sheet-steel enclosure, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Fabricate sheet-steel enclosures from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Fabricate steel enclosures from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A167 Type 300 series with ASM No. 4 general-purpose polished finish, with box dimensions and thickness of sheet steel in accordance with UL 50.

2.2.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Contain remote-control stations installed in indoor, clean, dry locations in NEMA Type 1 general-purpose, sheet-steel enclosures. Contain recessed remote-control stations in standard wall outlet boxes with matching corrosion-resistant steel flush cover plate.

Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Contain remote-control stations installed in industrial locations in NEMA Type 12 industrial-use, sheet-steel enclosures, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Fabricate sheet-steel enclosures from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Fabricate steel enclosures from corrosion-resistant, chromium-nickel steel sheet, conforming to ASTM A167, Type 300 series with ASM No. 4 general-purpose polished finish, with box dimensions and thickness of sheet steel in accordance with UL 50.

Install remote-control stations with the centerline 66 inches above the finished floor.

2.3 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, and NEMA AB 3.

2.3.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.
Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of NFPA 70 and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

2.3.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and UL 489.

Provide enclosed circuit breakers in nonhazardous locations as follows:

- Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose sheet steel enclosures.
- Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.
- Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.
- Contain circuit breakers installed in industrial locations in NEMA Type 12, industrial-use sheet steel enclosures, constructed to prevent the entrance of dust, lint, fibers and flyings, and oil and coolant seepage.
Fabricate steel enclosures from corrosion-resistant steel sheet, conforming to ASTM A167, 300 series corrosion-resistant steel, with box dimensions and thickness of sheet steel in accordance with UL 50.

2.4 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

2.5 CONTROL DEVICES

2.5.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

2.5.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.
Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

2.5.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz, magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.5.4 Pushbuttons and Switches

2.5.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.5.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.
Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.5.4.3 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

2.6 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

2.7 INDICATING LIGHTS

2.7.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with ANSI C78.23. Provide indicating lights color coded in accordance with NEMA ICS 6.

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.7.2 Switchboard Indicating Lights

For switchboard indicating lights, provide the manufacturer's standard transformer type units 120-volt input utilizing low-voltage lamps and convex lenses of the colors indicated. Provide indicating lights that are capable of being relamped from the switchboard front. Indicating lights utilizing resistors in series with the lamps are not permitted except in direct-current control circuits. Provide lights that have a press-to-test feature.

2.8 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.
3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB’s, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --
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DIVISION 26 - ELECTRICAL
SECTION 26 09 23.00 40
LIGHTING CONTROL DEVICES
08/10

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PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6 (1993; R 2011) Enclosures

UNDERWRITERS LABORATORIES (UL)

UL 773 (1995; Reprint Mar 2002) Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting

UL 773A (2006; Reprint Mar 2011) Standard for Nonindustrial Photoelectric Switches for Lighting Control

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Installation Drawings for light-sensitive control devices in accordance with the manufacturer's recommended instructions for installation.
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for Photoconductive Control Devices.

Submit Installation Drawings for Light-Sensitive Control Devices in accordance with paragraph entitled, "General Requirements," of this section.

Lighting Contactor; G

Photocell Switch; G

SD-06 Test Reports

Submit test reports for System Operation Tests in the presence of the Government Representative.

SD-08 Manufacturer's Instructions

Submit operational instructions for Light-Sensitive Control Devices consisting of the manufacturer's recommended procedures for operation.

PART 2 PRODUCTS

2.1 PHOTOCONDUCTIVE CONTROL DEVICES

Provide photoconductive control devices for natural daylight and darkness control of incandescent, fluorescent, and outdoor lighting luminaires including a photoconductive cell, thermal actuator, and snap-action switch in a weatherproof housing. Provide a control device which is, when attached to its mounting, weatherproof and constructed to exclude beating rain, snow, dust, and insects and capable of withstanding 96 percent relative humidity at 122 degrees F for 48 hours under operating conditions.

2.2 LIGHTING CONTACTOR

Provide NEMA ICS 2, electrically held contactor, rated 120 volts, 30 amperes, and 3 poles, with coils rated 120 volts. Rate contactor as indicated. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Provide contactor with silver alloy double-break contacts requiring no arcing contacts. Provide contactor with hand-off-automatic selector switch.

2.3 PHOTOCELL SWITCH

Provide photocell switch conforming to UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 volts ac, 60 Hz with single-throw contact for mechanically held contactors rated 1000 watts designed to fail to the ON position. Provide switch which turns on at or below 3 footcandles and off at 4 to 10 footcandles. Provide time
delay to prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

a. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ANSI C136.10, rated 1800 VA, minimum.

2.4 EQUIPMENT IDENTIFICATION

2.4.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in an inconspicuous place; the nameplate of the distributing agent is not acceptable.

2.4.2 Labels

Make markings related to control device type clear and locate to be readily visible to service personnel, but unseen from normal viewing angles when devices are in place.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Photoconductive Control Devices

Install photocell control devices in accordance with the manufacturer's installation instructions.

3.1.2 Magnetic Contactors

Provide magnetic contactors mechanically held, electrically operated, conforming to NEMA ICS 1 and NEMA ICS 2, suitable for 120 volts, single phase, 60 Hz, with coil voltage of 120 volts. Provide with maximum continuous ampere rating and number of poles as indicated on drawings. Provide enclosures for contactors mounted indoors conforming to NEMA ICS 6, Type 1. Provide each contactor with a spare, normally open auxiliary contact.

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.2 FIELD TESTING

Demonstrate that photoconductive control devices operate satisfactorily in the presence of the Government Representative.

Perform System Operation Tests in accordance with referenced standards in this section.

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SECTION 26 20 00

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PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

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1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM D709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.7 (2005) Requirements for Watthour Meter Sockets


ANSI C80.3 (2005) American National Standard for Electrical Metallic Tubing (EMT)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA FU 1 (2002; R 2007) Low Voltage Cartridge Fuses


NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 3 (2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC

NEMA ICS 4 (2010) Terminal Blocks

NEMA ICS 6 (1993; R 2011) Enclosures

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)

NEMA MG 1 (2011; Errata 2012) Motors and Generators


NEMA RN 1 (2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA ST 20 (1992; R 1997) Standard for Dry-Type Transformers for General Applications


NEMA VE 1 (2009) Standard for Metal Cable Tray Systems

NEMA WD 1 (1999; R 2005; R 2010) Standard for
General Color Requirements for Wiring Devices

NEMA WD 6 (2002; R 2008) Wiring Devices Dimensions Specifications


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

NFPA 70E (2012; Errata 2012) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607 (2002a) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-569 (2012c; Addendum 1 2013; Errata 2013) Commercial Building Standard for Telecommunications Pathways and Spaces

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; Reprint Jul 2012) Standard for Flexible Metal Conduit

UL 1063 (2006; Reprint Jul 2012) Machine-Tool Wires and Cables

UL 1242 (2006; Reprint Jul 2012) Standard for Electrical Intermediate Metal Conduit -- Steel

UL 1449 (2006; Reprint Jul 2012) Surge Protective Devices

UL 1569 (1999; Reprint Jan 2012) Standard for Metal-Clad Cables

UL 1660 (2004; Reprint Apr 2008) Liquid-Tight Flexible Nonmetallic Conduit

UL 1699 (2006; Reprint Feb 2011) Arc-Fault Circuit-Interrupters

UL 198M (2003; Reprint Feb 2013) Standard for Mine-Duty Fuses
UL 20: (2010; Reprint Feb 2012) General-Use Snap Switches

UL 360: (2013) Liquid-Tight Flexible Steel Conduit

UL 4: (2004; Reprint Oct 2008) Standard for Armored Cable

UL 4248: (2007) UL Standard for Safety Fuseholders

UL 44: (2010) Thermoset-Insulated Wires and Cables

UL 467: (2007) Grounding and Bonding Equipment

UL 489: (2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 498: (2012; Reprint Nov 2012) Attachment Plugs and Receptacles

UL 50: (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations

UL 506: (2008; Reprint Oct 2012) Specialty Transformers

UL 508: (1999; Reprint Apr 2010) Industrial Control Equipment

UL 514A: (2013) Metallic Outlet Boxes

UL 514B: (2012) Conduit, Tubing and Cable Fittings

UL 514C: (1996; Reprint Nov 2011) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 6: (2007; Reprint Nov 2010) Electrical Rigid Metal Conduit—Steel

UL 651: (2011; Reprint Mar 2012) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

UL 67: (2009; Reprint Jan 2013) Standard for Panelboards


UL 719: (2006; Reprint Dec 2010) Nonmetallic-Sheathed Cables

UL 797: (2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel

UL 817: (2001; Reprint Dec 2012) Standard for Cord
1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Panelboards; G
Transformers; G
Cable trays; G
Motor control centers; G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

Wireways; G
Marking strips drawings; G

SD-03 Product Data

Receptacles; G
Circuit breakers; G
Switches; G
Transformers; G
Enclosed circuit breakers; G
Motor controllers; G
Combination motor controllers; G
Meter base only; G
Surge protective devices; G

Submittals shall include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test; G
Grounding system test; G
Transformer tests; G
Ground-fault receptacle test; G

SD-07 Certificates

Fuses; G

SD-09 Manufacturer's Field Reports

Transformer factory tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

1.5 QUALITY ASSURANCE

1.5.1 Fuses

Submit coordination data as specified in paragraph, "FUSES" of this section.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in
these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Government Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
PART 2  PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2, UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel compression type.
2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 CABLE TRAYS

NEMA VE 1. Cable trays shall form a wireway system, and shall be of nominal 6 inch depth as indicated. Cable trays shall be constructed of aluminum that has been zinc-coated after fabrication. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius.

2.3.1 Basket-Type Cable Trays

Provide size as indicated with maximum wire mesh spacing of 2 by 4 inch.

2.3.2 Trough-Type Cable Trays

Provide size as indicated.

2.3.3 Ladder-Type Cable Trays

Provide size as indicated with maximum rung spacing of 9 inches.

2.3.4 Channel-Type Cable Trays

Provide size as indicated. Trays shall be one-piece construction having slots spaced not more than 4 1/2 inches on centers.

2.3.5 Solid Bottom-Type Cable Trays

Provide size as indicated. Solid covers shall not be provided.

2.3.6 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.4 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4.1 Outlet Boxes for Telecommunications System

Provide standard type 4 inches square by 2 1/8 inches deep. Outlet boxes for wall-mounted telecommunications outlets shall be 4 by 2 1/8 by 2 1/8 inches deep. Depth of boxes shall be large enough to allow manufacturers' recommended conductor bend radii. Outlet boxes for fiber optic telecommunication outlets shall include a minimum 3/8 inch deep single or two gang plaster ring as shown and installed using a minimum 1 inch conduit system. Outlet boxes for handicapped telecommunications station shall be 4 by 2 1/8 by 2 1/8 inches deep.
2.4.2 Clock Outlet for Use in Other Than Wired Clock System

Provide outlet box with plastic cover, where required, and single receptacle with clock outlet plate. Receptacle shall be recessed sufficiently within box to allow complete insertion of standard cap, flush with plate. Suitable clip or support for hanging clock shall be secured to top plate. Material and finish of plate shall be as specified in paragraph "DEVICE PLATES" of this section.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.6 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.6.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and capacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.6.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.6.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.6.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase
   (1) Phase A - black
   (2) Phase B - red
(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown
(2) Phase B - orange
(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.6.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.6.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.6.6 Nonmetallic Sheathed Cable

UL 719, Type NM or NMC.

2.6.7 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.6.8 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.6.9 Mineral-Insulated, Metal-Sheathed Cable

UL listed; NFPA 70, Type MI cable. Sheathing containing asbestos fibers shall not be used.

2.6.10 Flat Conductor Cable

UL listed; NFPA 70, Type FCC.

2.6.11 Cable Tray Cable or Power Limited Tray Cable

UL listed; type TC or PLTC.
2.6.12 Cord Sets and Power-Supply Cords
UL 817.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be nylon or lexan, minimum 0.03 inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations." Device plates in areas normally accessible to prisoners shall be brown or ivory finish nylon-device plates rated for high abuse. Test device plates for compliance with UL 514A and UL 514C for physical strength. Attach device plates with spanner head bolts.

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Handles shall be brown thermoplastic. Wiring terminals shall be screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Switch with Red Pilot Handle

NEMA WD 1. Provide pilot lights that are integrally constructed as a part of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated 20 amps and 120 volts or 277 volts as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.8.3 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.8.4 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 4x, enclosure as indicated per NEMA ICS 6.
2.9 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch panel and control center. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.9.1 Fuseholders

Provide in accordance with UL 4248.

2.9.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-1 RK-5 time-delay type. Associated fuseholders shall be Class R only.

2.9.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.9.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 198M, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.10 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of brown as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.10.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle shall be switched when installed.

2.10.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.10.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.
2.10.4 Plugs

Provide heavy-duty, rubber-covered three-, four-, or five-wire cord of required size, install plugs thereon, and attach to equipment. Plugs shall be UL listed with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

2.11 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped unless indicated otherwise. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering. Panelboards shall be listed and labeled for their intended use. Panelboard shall have nameplates in accordance with paragraph "FIELD FABRICATED NAMEPLATES".

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering. Panelboard shall have nameplates in accordance with paragraph "FIELD FABRICATED NAMEPLATES".

2.11.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No. 10 gauge if flush-mounted or mounted outdoors, and not less than No. 12 gauge if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph "PAINTING". Outdoor cabinets shall be of NEMA 3R raintight with conduit hubs welded to the cabinet. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that
expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets.

2.11.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.11.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.11.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11.3.2 Circuit Breaker With GFI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI GFI devices, for personnel protection.

2.11.3.3 Arc-Fault Circuit-Interrupters

UL 489, UL 1699 and NFPA 70. Molded case circuit breaker shall be rated as indicated. Two pole arc-fault circuit-interrupters shall be rated 120/240 volts. The provision of (two) one pole circuit breakers for shared neutral circuits in lieu of (one) two pole circuit breaker is unacceptable. Provide with "push-to-test" button.

2.11.4 Fusible Switches for Panelboards

NEMA KS 1, hinged door-type. Switches serving as motor disconnect means shall be horsepower rated.

2.12 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated.
2.13 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs); shall conform to UL 508 and UL 489 and shall be provided as shown. MSCP shall consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. MSCP shall be rated in accordance with the requirements of NFPA 70.

2.14 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.14.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 480V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, shall be energy efficient type. Minimum efficiency, based on factory test results, shall not be less than NEMA Class 1 efficiency as defined by NEMA TP 1.

2.15 MOTORS

NEMA MG 1 hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Unless otherwise indicated, motors rated 1 HP and above shall be continuous duty type.

2.15.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.15.2 Premium Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10. In addition, continuous rated, polyphase squirrel-cage medium induction motors shall meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven
equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.15.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.15.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment as specified herein. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.16 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton
on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.16.1 Control Wiring

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.16.2 Control Circuit Terminal Blocks

NEMA ICS 4. Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Government Representative and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.16.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph "CONTROL CIRCUIT TERMINAL BLOCKS" above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.
2.16.3 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded.

2.16.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.16.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.16.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.16.7 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.16.8 Reduced-Voltage Controllers

Provide for polyphase motors 15 horsepower and larger. Reduced-voltage starters shall be single-step, closed transition autotransformer, solid state-type, or as indicated, and shall have adjustable time interval between application of reduced and full voltages to motors. Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of motor-generator sets, centrifugally operated equipment, or reciprocating compressors provided with automatic unloaders.

2.17 MOTOR CONTROL CENTERS

UL 845, NEMA ICS 2, NEMA ICS 3. Wiring shall be Class I, Type C, in NEMA Type 12 enclosure. Provide control centers suitable for operation on 480-volt, 3-phase, 4-wire, 60 Hz system and shall have minimum short-circuit withstand and interrupting rating of 65,000 amperes rms symmetrical. Incoming power feeder shall be cable entering at the top of enclosure and terminating on main protective device. Main protective device shall be molded case circuit breaker rated at 65,000 amperes rms symmetrical interrupting capacity. Arrange busing so that control center can be expanded from both ends. Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring.
2.17.1 Bus Systems

Provide the following bus systems. Power bus shall be braced to withstand fault current of 65,000 amperes rms symmetrical. Wiring troughs shall be isolated from horizontal and vertical bus bars.

2.17.1.1 Horizontal and Main Buses

Horizontal bus shall have continuous current rating of 1200 amperes. Main bus shall be copper, silver-plated enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.17.1.2 Vertical Bus

Vertical bus shall have continuous current rating of 300 amperes, and shall be copper, silver-plated. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.17.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

2.17.1.4 Neutral Bus

Insulated neutral bus shall be provided continuous through the motor control center; neutral shall be full rated. Lugs of appropriate capacity shall be provided, as required.

2.17.2 Motor Disconnecting Devices and Controllers

Shall comply with paragraph "COMBINATION MOTOR CONTROLLERS".

2.17.3 Combination Motor Controllers

UL 508 and other requirements in paragraph, "MOTOR CONTROLLERS". Controller shall employ molded case circuit breaker for branch circuit protection. Minimum short circuit withstand rating of combination motor controller shall be 25,000 rms symmetrical amperes. Circuit breakers for combination controllers shall be magnetic only.

2.17.4 Space Heaters

Space heaters shall be provided where indicated on the drawings and shall be controlled using an adjustable 50 to 90 degrees F thermostat, magnetic contactor, and a molded-case circuit breaker and a 480-120 volt single-phase transformer. The space heaters shall be 250-watt, 240 volt strip elements operated at 120 volts and shall be supplied from the motor control center bus wired to terminal blocks for connection to 120-volt single-phase power sources located external to the control centers. The contactors shall be open type, electrically-held, rated 30 amperes, 2-pole, with 120-volt ac coils.

2.18 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and
2.19 GROUNDING AND BONDING EQUIPMENT

2.19.1 Ground Rods

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.19.2 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated.

2.20 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.21 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Provide red laminated plastic label with white center core where indicated. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.22 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. The marking shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.23 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING.

2.24 WIREWAYS

UL 870. Material shall be steel galvanized 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw-cover NEMA 12 enclosure per NEMA ICS 6.
2.25 METER BASE ONLY

ANSI C12.7. Provide NEMA Type 3R, box-mounted socket, ringless, having jaws compatible with requirements of a class: 200 and Form: 2S self contained watthour meter. Provide gray plastic closing cover and bypass links. Provide manufacturers standard enclosure color unless otherwise indicated.

2.26 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices which comply with UL 1449 at the service entrance panelboards and MMC. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
  Each phase to neutral (L-N)
  Neutral to ground (N-G)
  Phase to ground (L-G)

FOR DELTA CONNECTIONS-
  Phase to phase (L-L)
  Phase to ground (L-G)

Surge protective devices at the service entrance shall have a minimum surge current rating of 80,000 amperes per mode minimum and downstream protectors shall be rated 40,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating (SVR) shall be:

- 500V for 120V, single phase system
- 500V for 120/240V, single phase system
- 500V for 208Y/120V, three phase system
- 900V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:

- 150V for 120V, single phase system
- 300/150V for 120/240V, single phase system
- 300/150V for 208Y/120V, three phase system
- 600/320V for 480Y/277V, three phase system

EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.

2.27 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Dark Gray. Provide manufacturer's coatings.
for touch-up work and as specified in paragraph "FIELD APPLIED PAINTING".

2.28  SOURCE QUALITY CONTROL

2.28.1  Transformer Factory Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3  EXECUTION

3.1  INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1  Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2  Overhead Service

Overhead service conductors into buildings shall terminate at service entrance fittings or weatherhead outside building.

3.1.3  Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.3.1  Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph "FIELD FABRICATED NAMEPLATES". Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.4  Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 3/4 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated
walls, fire-rated partitions, or fire-rated floors shall be firestopped in accordance with Section 07 84 00, FIRESTOPPING.

3.1.4.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4.2 Metal Clad Cable

Install in accordance with NFPA 70, Type MC cable.

3.1.4.3 Armored Cable

Install in accordance with NFPA 70, Type AC cable.

3.1.4.4 Flat Conductor Cable

Install in accordance with NFPA 70, Type FCC cable.

3.1.5 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.5.1 Restrictions Applicable to Aluminum Conduit

a. Do not install underground or encase in concrete or masonry.
b. Do not use brass or bronze fittings.
c. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.2 Restrictions Applicable to EMT

a. Do not install underground.
b. Do not encase in concrete, mortar, grout, or other cementitious materials.
c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.
d. Do not use in hazardous areas.
e. Do not use outdoors.
f. Do not use in fire pump rooms.
g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).
3.1.5.3 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

b. Electrical Nonmetallic Tubing

(1) Do not install underground.

(2) Do not encase in concrete except when provided with fittings identified for this purpose are used for connections.

(3) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(4) Do not use in hazardous areas.

(5) Do not use outdoors.

(6) Do not use in sizes larger than 2 inch.

(7) Do not run exposed in buildings exceeding three floors above grade, where "first floor" is as defined in NFPA 70.

(8) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph "FLEXIBLE CONNECTIONS". Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.5 Service Entrance Conduit, Overhead

Rigid steel or IMC from service entrance to service entrance fitting or weatherhead outside building.
3.1.5.6 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.5.7 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.5.8 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.5.9 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.5.10 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.5.11 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Do not stack conduits more than two diameters high with minimum vertical separation of 3 inches. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab.

3.1.5.12 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.5.13 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by
machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.5.14 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.5.15 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.5.16 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 3/4 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.6 Busway Installation

Installation shall comply at minimum with NFPA 70. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 5 foot maximum intervals, and brace to
3.1.7 Cable Tray Installation

Install and ground in accordance with NFPA 70. In addition, install and ground telecommunications cable tray in accordance with TIA-569, and TIA J-STD-607. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support in accordance with manufacturer recommendations but at not more than as indicated. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section, except use No. 1/0 aluminum wire if cable tray is aluminum. Terminate cable trays 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Penetrations shall be firestopped in accordance with Section 07 84 00, FIRESTOPPING. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support as indicated intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section. Use No. 1/0 aluminum wire if cable tray is aluminum. Conductors that run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushing, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.8 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for
use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.8.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets shall be a minimum of 4 inches square by 2 1/8 inches deep, except for wall mounted telephones and outlet boxes for handicap telephone stations. Mount outlet boxes flush in finished walls.

3.1.8.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.8.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.9 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles 18 inches above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets shall be mounted at height 60 inches above finished floor. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet. Measure mounting heights of receptacle outlet boxes in the hazardous area to the bottom of the outlet box.
3.1.10 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened within 12 inches of each turn or offset and at 33 inches maximum intervals. Make cable terminations in accordance with NFPA 70 and cable manufacturer's recommendations. Single-conductor cables of a circuit, having capacities of more than 50 amperes, shall terminate in a single box or cabinet opening. Individual conductors in all outlets and cabinets shall be color-coded.

3.1.11 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.11.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.12 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.12.1 Splices of Aluminum Conductors

Make with solderless circumferential compression-type, aluminum-bodied connectors UL listed for AL/CU. Remove surface oxides from aluminum conductors by wire brushing and immediately apply oxide-inhibiting joint compound and insert in connector. After joint is made, wipe away excess joint compound, and insulate splice.
3.1.13 Terminating Aluminum Conductors

3.1.13.1 Termination to Copper Bus

Terminate aluminum conductors to copper bus either by: (a) inline splicing a copper pigtail, of ampacity at least that of aluminum conductor, or (b) utilizing circumferential, compression-type, aluminum-bodied terminal lug UL listed for AL/CU, and steel Belleville cadmium-plated hardened steel spring washers, flat washers, bolts, and nuts. Carefully install Belleville spring washers with crown up toward nut or bolt head, with concave side of Belleville bearing on heavy-duty, wide series flat washer of larger diameter than Belleville. Tighten nuts sufficiently to flatten Belleville, and leave in position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

3.1.13.2 Termination to Aluminum Bus

Terminate aluminum conductors to aluminum bus by using aluminum nuts, bolts, washers, and compression lugs. Wire brush and apply joint compound to conductor prior to inserting in lug. Lubricate hardware with joint compound prior to making connection. When bus contact surface is unplated, scratch-brush and coat with joint compound, without grit.

3.1.14 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.15 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.16 Grounding and Bonding

Provide In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall be made on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with
TIA J-STD-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.16.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 2 additional rods not less than 6 feet on centers. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Government Representative who will decide on the number of ground rods to add.

3.1.16.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.16.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, ground buses shall be provided and connected to the building grounding system. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.16.4 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact the Government Representative for further instructions.
3.1.17 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.18 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS. Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give the Government Representative 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.5.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600
volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.5.4 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to the Government Representative, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --
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PART 1  GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B1.1  (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B1.20.1  (1983; R 2006) Pipe Threads, General Purpose (Inch)

ASTM INTERNATIONAL (ASTM)

ASTM B187  (2011) Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


NEMA C12.4  (1984; R 2011) Registers - Mechanical Demand


NEMA ICS 2  (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

1.3.1 Rules

Provide equipment conforming to the requirements of NFPA 70 unless more
stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment shall meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. Immediately notify the Government Representative of any requirements of the specifications or Contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

1.3.2 Coordination

The general arrangement of the motor control centers, switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Government Representative. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. Completely assemble all equipment at the factory. The motor control centers and switchboards may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G
Shop Drawings; G
Motor Control Centers; G
Switchboards; G
Panelboards; G

SD-03 Product Data

Equipment; G
Factory Tests

SD-06 Test Reports

Factory Tests

SD-07 Certificates

Motor Control Centers

1.5 DELIVERY, STORAGE, AND HANDLING

Submit 6 copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications, within 30 calendar days after date of receipt of notice to proceed for approval. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case.
circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Ship the equipment as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. All spare parts and accessories shall be carefully packaged and clearly marked.

1.6 MAINTENANCE

1.6.1 Accessories and Tools

Furnish a complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus.

1.6.2 Extra Materials

Furnish spare parts as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

a. 2 Fuses of each type and size.
b. 1 Circuit breaker auxiliary switch.
c. 2 Operating coils for each size ac contactor.
d. 2 Complete sets of 3-pole stationary and moving contact assemblies for each size ac contactor.
e. 3 Contactor overload relays of each type and rating, each relay with a complete set of contact blocks.
f. 1 Spare set of heater elements for each heater rating provided.
g. 2 Indicating lamp assemblies of each type.
h. 1 Control relay of each type and rating.
i. 1 Contactor auxiliary contact of each type.
j. 4 One quart containers of finish paint for indoor equipment.
k. 2 One quart containers of the paint used for the exterior surfaces of outdoor equipment.
PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are standard products of a manufacturer regularly engaged in their manufacture and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening and that conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, submit, after award, a statement of the exact nature of the deviation, and complete specifications for the materials proposed for use, for the approval of the Government Representative.

2.2 NAMEPLATES

Provide nameplates made of laminated sheet plastic or of anodized aluminum approximately 1/8 inch thick, engraved to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 1/2 inch high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

a. Motor Control Centers
b. Individual items of equipment mounted in the Motor Control Centers
c. Switchboards
d. Group-mounted circuit breakers in Switchboard
e. Panelboards

Provide equipment of the withdrawal type with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

2.3 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Government Representative, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

2.4 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of UL 489 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the
drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

2.4.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. Submit 6 copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions, within 10 calendar days after date of receipt of notice to proceed, for the approval of the Government Representative. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

2.4.2 480-Volt AC Circuits

Circuit breakers for 480-volt or 277/480-volt ac circuits shall be rated 600 volts ac, and shall have an UL listed minimum interrupting capacity of 14,000 symmetrical amperes at 600 volts ac.

2.4.3 120/240-Volt AC Circuits

Circuit breakers for 120-volt ac circuits shall be rated not less than 120/240 or 240 volts ac, and shall have a UL listed minimum interrupting capacity of 10,000 symmetrical amperes.

2.5 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.6 TERMINAL BLOCKS

Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to
each terminal. The terminal arrangement shall be subject to the approval of the Government Representative and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. Submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.6.1 Types of Terminal Blocks

2.6.1.1 Short-Circuiting Type

Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph "CONTROL CIRCUIT TERMINAL BLOCKS" above.

2.6.1.2 Load Type

Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.6.2 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables. Prints of drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.
2.7 MOTOR CONTROL CENTERS

Each motor control center shall be designed for operation on 480-volts ac, 3-phase, 60-Hz system, and the equipment shall conform to all the applicable requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4, and NEMA ICS 6. Vertical sections and individual units shall be listed and labeled under UL 845 where ever possible. In lieu of the UL listing, certification from any nationally recognized, adequately equipped, testing agency that the individual units and vertical sections have been tested and conform to the UL requirements of that agency will be acceptable when approved by the Government Representative.

a. Certification of factory test reports. Certification shall be signed by official authorized to certify on behalf of the manufacturer, attesting that the motor control center meets the specified requirements. The statement shall be dated after the award of this contract, shall state the Contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

b. The motor control center shall be NEMA Class II, Type B, motor control centers in accordance with NEMA ICS 2. Submit 6 copies of electrical equipment drawings, within 30 calendar days after date of receipt of notice to proceed, for the approval of the Government Representative.

c. Submit an individual wiring diagram for each motor control center. Wiring diagrams shall be in a form showing physical arrangement of the control center with interconnecting wiring shown by lines or by terminal designations (wireless). Provide a single-line diagram, equipment list and nameplate schedule for each switchboard and panelboard.

2.7.1 Enclosures

Each motor control center shall consist of the required number of vertical sections of 90 inches nominal height, bolted together, with steel channel sills and suitable for mounting against a wall. Vertical section shall be 20 inches deep and buses, control wiring, control transformers, small power transformers, terminal blocks, line terminals, cable supports, and clamps shall be accessible from the front. Enclosure shall be NEMA Type 1 gasketed. The control centers shall be fabricated from smooth select steel sheets shaped and reinforced to form rigid free-standing structures. Metal thickness for enclosures shall be not less than specified in NEMA ICS 6 without exception. Vertical edges of sections exposed to view shall be so fabricated and bolted that the joints will not pass a 1/16 inch gage. Each structure shall be designed for addition of future sections required. Individual compartments shall be isolated from adjacent compartments.

2.7.1.1 Unit Compartments

Each operating unit shall contain equipment as shown on the drawings, mounted in an individual cell. The unit assembly, except main circuit breakers, panelboards, and auxiliary control devices, shall be drawout type removed from the front, without rear access or disturbing other units in the control center assembly. All drawout type unit assemblies shall have positive guide rail system to ensure alignment of connection to vertical bus. Units shall be mechanically interlocked with the door to prevent
removal while in the energized position. Each removable unit shall have provision for padlocking in a position in which it is disconnected from the vertical bus although not removed from the stationary structure. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Bus closing plugs shall be provided for all unused openings in vertical bus barriers.

2.7.1.2 Motor Control Center Doors and Covers

Each unit compartment, including blank compartments for future use, shall be provided with either a flange-formed or a rolled-edge door. Each door shall be mounted on fully-concealed or continuous full-length piano-type hinges and shall be provided with positive fasteners. Door sag shall be prevented by proper alignment of hinges made of sufficiently strong material. The door fastenings shall be so interlocked to prevent opening when the equipment is energized. The external operating handle shall clearly indicate whether the equipment is in an "ON", "OFF" or "TRIPPED" position.

2.7.1.3 Horizontal Wireways

Structure shall have a minimum 6 inches high wireway at the top and a 12 inches minimum wireway at the bottom. Both horizontal wireways shall run the length of the structure. Cover plates shall be provided on the side of the assembly to permit extension of the horizontal bus and wireway when vertical sections are added.

2.7.1.4 Vertical Wireways

Vertical wireways shall be provided in all vertical sections accepting multiple plug-in components. Vertical wireways shall connect with horizontal wireways at the top and bottom and be a minimum 4 inches wide. Barriers shall be provided in sections containing both ac and dc vertical buses. Doors shall be provided on each vertical wireway. The exposed surface of any door shall not deviate more than 1/16 inch from a true plane.

2.7.1.5 Sills

Channel iron foundations, complete with bolts and drilled holes for grouting and anchoring to the floor, shall be furnished for the complete length (front and rear) of each motor control center assembly. The channels shall be designed for flat mounting and maximum channel depth shall be 1-1/2 inches. Additional channel or substantial metal trim shall be provided flush with the end panels to completely enclose the bases across the ends of the equipment assemblies.

2.7.1.6 Shutters

Drawout units shall have shutters which close when the unit is withdrawn to isolate the vertical bus.

2.7.2 Buses

All buses shall be of copper or aluminum shall be tin or silver-plated throughout. Copper or aluminum bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B187 and ASTM B317. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. The bus
ratings shall be based on a 65 degree Celsius maximum temperature rise in accordance with UL 845 requirements. Bus shall have a short-circuit current rating of not less than 65,000 RMS symmetrical amperes. All bus work shall be supported on wet process porcelain insulators, glass polyester, or suitable molded material.

2.7.2.1 Horizontal Bus

Each control center assembly shall be provided with a three-phase main horizontal bus, with a continuous current rating not less than 800 amperes, located across the top of each vertical section. The ends of horizontal buses shall be drilled for future extensions.

2.7.2.2 Vertical Bus

Each vertical section shall be provided with a three-phase vertical bus with a continuous current rating of 300 amperes connected to the horizontal bus by brazing, welding, or bolting. Where the incoming feeder breakers are located at the bottom of a control center, the vertical bus in that section shall be rated the same as the main horizontal bus. Vertical buses shall extend from the horizontal bus to the bottom of the lowest available unit mounting space. The vertical bus shall be isolated from wireways and equipment in compartments.

2.7.2.3 Ground Bus

A copper ground bus shall be provided full width at the bottom of the motor control center line-up. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.7.2.4 Neutral Bus

A half rated neutral bus shall be furnished continuous through the control center. Lugs of appropriate capacity will be furnished.

2.7.3 Combination Starters

Combination motor controller units shall contain motor circuit protectors, auxiliary and pilot devices and a magnetic contactor with thermal overload relays. The ratings of motor circuit protectors, air circuit breakers, contactors, motor controllers and other devices shall be as shown on the drawings. All combination motor controller units shall have short circuit ratings equal to 22,000 RMS symmetrical amperes AC or greater. Where control push-buttons, indicating lamps, "Hand-Off-Automatic" switches, and similar control devices are associated with a unit, they shall be mounted on the unit compartment door. Door-mounted components shall not interfere with access within the compartments. Motor circuit protectors shall be only part of the combination starters as required by NFPA 70 and shall conform to all requirements of paragraph "MOLDED CASE CIRCUIT BREAKERS", except that trip units shall have provision for locking the selected trip setting.

2.7.3.1 Magnetic Contactors

Magnetic contactors shall be of the NEMA sizes indicated on the drawings. The rating, performance and service characteristics shall conform to the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Contactors for motor control shall be rated for
full-voltage starting (Class A controllers). Contactors shall be suitable for at least 200,000 complete operations under rated load without more than routine maintenance. The interruption arc and flame shall be minimized by suitable arc chutes or other means so that no damage will be done to other portions of the device. The arc chutes, if provided, shall be easily removable without removing or dismantling other parts. The contacts shall be easily removable. All current-carrying contact surfaces shall be silver-surfaced or of other approved material to prevent the formation of high resistance oxides. The contactor shall operate without chatter or perceptible hum while energized. Coils shall be suitable for continuous operation 120-volt ac circuits. Alternating-current contactors shall be three-pole, except where otherwise noted, and shall be insulated for 600 volts ac and of the electrically-operated, magnetically-held type. Direct-current contactors shall be two-pole, suitable for controlling circuits operating at 125 volts dc, insulated for 250 volts dc, electrically-operated, magnetically-held type and adequate for full-voltage motor starting service.

2.7.3.2 Auxiliary Contacts

Each controller shall be provided with a minimum of three auxiliary contacts which can be easily changed from normally open to normally closed. Where indicated on the drawings, a fourth auxiliary contact and red and green indicating lights shall be provided.

2.7.3.3 Overload Relays

Except as otherwise indicated, each controller shall be provided three NEMA Class 20 thermal overload relays with external manual reset. Prior to shipment of the control centers, the Government Representative will furnish the ratings of the heater elements to be installed in the relays by the Contractor.

2.7.3.4 Individual Control Transformers

Where 120 volt ac control of contactors is indicated or required, individual control transformer shall be provided on the line side of the unit disconnect. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the control functions indicated. Transformers shall be installed with primary fuses. Except as otherwise indicated on the drawings, each control transformer shall be provided with a fuse in one secondary lead and shall have the other secondary lead grounded.

2.7.3.5 Control Circuit Disconnects

Control circuit power shall disconnect when the unit compartment is opened.

2.7.4 Molded Case Circuit Breakers in Unit Compartments

Molded case circuit breakers for installation in unit compartments shall meet the requirements of paragraph "MOLDED CASE CIRCUIT BREAKERS" above.

2.7.5 Panelboards for Motor Control Centers

Panelboards shall meet the requirements of paragraph "PANELBOARDS".
2.7.6 Distribution Transformers

Dry type transformers for power and lighting loads shall be furnished with voltage and kVA ratings as indicated on the drawings. The transformers shall conform to the requirements for general-purpose transformers in NEMA ST 20. Each transformer shall be protected on the primary side with a molded case circuit breaker as indicated on the drawings.

2.7.7 Wiring for Motor Control Centers

All wiring shall meet the requirements of paragraph "WIRING" above. Provide heavy-duty clamp type terminals for terminating all power cables entering the control centers.

2.7.7.1 Contractor's Wiring

The Contractor's wiring shall be formed into groups, suitably bound together, properly supported and run straight horizontally or vertically. There shall be no splices in the wiring. The manufacturer's standard pressure-type wire terminations for connections to internal devices will be acceptable. Terminal blocks shall be added for wiring to devices having leads instead of terminals. Ring tongue indented terminals shall be used on all wires terminated on control terminal blocks for external or interpanel connections and at shipping splits. All stud terminals shall have contact nuts and either locking nuts or lockwashers.

2.7.7.2 External Connections

Power and control cables will enter the control centers at the top. Where power and control entry points are not shown, and terminal blocks are not given on the drawings, the Government will furnish this information to the Contractor after award of contract.

2.7.7.3 Terminal Blocks

Terminal blocks shall meet the requirements of paragraph "TERMINAL BLOCKS" above. In no case shall the terminals provided for circuit breakers or contactors accommodate less than the number or size of conductors shown on the drawings. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.7.8 Accessories and Control Devices

Control accessories shall be provided, and shall be suitable for mounting on the front of, or inside, the control centers as indicated on the drawings. Control accessories shall meet the applicable requirements of NEMA ICS 2. Relays and other equipment shall be so mounted that mechanical vibration will not cause false operation.

2.7.8.1 Control Stations

Push-button stations and selector switches shall conform to NEMA ICS 2, shall be of the heavy-duty, oil-tight type, rated 600 volts ac, and have a contact rating designation of A600. Switches shall be provided with escutcheon plates clearly marked to show operating positions.
2.7.8.2 LED Indicating Lights

Red and green LED's shall be furnished where shown on the drawings, indicating contact "open" and "closed" position. The LED's shall be accessible and replaceable from the front of the control center through a finished opening in the compartment door. The LED assemblies shall be of the heavy duty oiltight, watertight, and dusttight type.

2.7.8.3 Control Relays

Control relays shall be of the electrically operated, magnetically held, self-reset, open type, suitable for mounting inside the starter compartments, and shall be 125-volt dc 120-volt ac. Contacts shall be as indicated on the drawings and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.7.8.4 Timing Relays

Timers shall be pneumatic type. They shall be suitable for mounting inside the control center and shall be rated 120 volts ac, 60 Hz. Instantaneous and time delay contacts shall be provided as indicated on the drawings, and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2. Means shall be provided for manual adjustment over a range as indicated on the drawings.

2.7.8.5 Alternators

Alternators 120-volt, 60 Hz, single-phase, open type, suitable for mounting inside of control center as indicated. Alternators shall automatically cycle two motor starters in such a manner that No. 1 will lead and No. 2 will lag during the first cycle, and during the second cycle No. 2 will lead and No. 1 will lag, and the third cycle will repeat the first cycle. The duration of a cycle will be determined by an adjustable time delay. Contacts shall have a minimum contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.7.8.6 Elapsed-Time Meters

Hour-indicating time meters shall have 6- digit registers with counter numbers at least 1/4 inch high. White numbers on black backgrounds shall provide hour indication with the last digit in contrasting colors to indicate tenths of an hour. The enclosure shall be 3-1/2 inches square and dust resistant. Operating voltage shall be 120 volts ac. They shall be of the nonreset type.

2.7.9 Feeder Tap Units

Feeder tap units shall be provided as indicated on the drawings.

2.7.10 Metering Section

Metering section shall be provided with instruments as indicated on the drawings.

2.7.10.1 Instrument Transformers

All transformers used for metering shall meet the requirements of NEMA/ANSI C12.11 and IEEE C57.13. Voltage transformers shall be protected with removable primary and secondary fuses. Fuses shall be installed in
each ungrounded lead and located adjacent to the transformers in an easily accessible place. If cable connections to current transformer primary are required, terminals of an approved solderless type and proper size shall be furnished. If current transformers are connected to buses, proper connections shall be furnished, complete with bolts, nuts, washers and other accessories.

2.7.10.2 Ammeters

Switchboard type ammeter shall be provided where indicated on the drawings. Ammeter, range 0 to 800 amperes, complete with selector switch having off position and positions to read each phase current. Meters shall be long scale 6.8 inches), semiflush rectangular, indicating type mounted at eye level.

2.7.10.3 Voltmeters

Switchboard type voltmeter shall be provided where indicated on the drawings. Voltmeter, range 0 to 600 volts, complete with selector switch having off position and positions to read each phase to phase voltage. Meters shall be long scale 6.8 inches, semiflush rectangular, indicating type mounted at eye level.

2.7.10.4 Watthour Meters

Watthour meters shall conform to ANSI C12.1 and NEMA/ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15-minute, cumulative form, demand register meeting NEMA C12.4 and provided with not less than two and one-half stators.

2.7.10.5 Switches

All metering switches shall be of the rotary switchboard type with handles on the front and operating contact mechanisms on the rear of the panels. Control switches shall be suitable for operation on 600-volt AC or 250-volt DC circuits. All such switches shall be capable of satisfactorily withstanding a life test of at least 10,000 operations with rated current flowing in the switch contacts. Selector switches shall be maintained-contact type with the required number of positions, and shall have round notched, or knurled handles. Ammeter switches shall not open the secondary circuits of current transformers at any time. Instrument switches for potential selection shall have oval handles.

2.7.11 Space for Mounting PLC's

Space for mounting of Programmable Logic Controllers (PLC's) shall be provided as indicated on the drawings.

2.8 SWITCHBOARDS

The switchboards shall be dead-front switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, and other devices as shown on the drawings. Switchboards shall be fully rated for a short-circuit current of 22,000 symmetrical amperes RMS AC.
2.8.1 Enclosure

Each switchboard enclosure shall be NEMA type 2, built with selected smooth sheet steel panels of not less than No. 14 gage. Exposed panels on the front and ends shall have bent angle or channel edges with all corner seams welded and ground smooth. The front outside surfaces shall not be drilled or welded for the purpose of attaching wires or mounting devices if such holes or fastenings will be visible from the front. The front panels shall be made in sections flanged on four sides and attached to the framework by screws and arranged for ready removal for inspection or maintenance. Ventilating openings shall be provided as required and shall preferably be of the grille type. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Switchboards shall be mounted as shown on the drawings and mounting materials shall be furnished as indicated. All interior and exterior steel parts shall be treated to inhibit corrosion and shall be painted as specified in paragraph "PAINTING".

2.8.2 Bus

All buses shall be of copper or aluminum and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated throughout. Copper or aluminum bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B187 and ASTM B317. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. Horizontal and vertical power buses have minimum current ratings as shown on the drawings. The buses shall be insulated for not less than 600 volts. Shop splices and tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. The buses shall be mounted on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and shall be braced to withstand not less than 22,000 symmetrical amperes ac.

2.8.3 Grounding Bus

A copper ground bus, rated not less than 300 amps, extending the entire length of the assembled structure, shall be mounted near the bottom of enclosure. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.8.4 Components

Each switchboard shall be equipped with molded-case circuit breakers conforming to paragraph "MOLDED CASE CIRCUIT BREAKERS" and with frame sizes, trip ratings, and terminal connectors for attachment of outgoing power cables as shown on the drawings. The circuit breakers shall be individually stationary mounted, as shown on the drawings, and shall be operable and removable from the front. Where shown on the drawings, circuit breakers shall be enclosed in individual compartments. The group-mounted circuit breakers shall be provided complete with bus work in an integrated assembly on the switchboard and shall conform to the applicable requirements of paragraph "PANELBOARDS".

2.9 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch
circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings. Panelboards shall be fully rated for a short-circuit current of 22,000 symmetrical amperes RMS ac.

2.9.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No 10 gage if flush-mounted or mounted outdoors, and not less than No 12 gage if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph "PAINTING". Outdoor cabinets shall be of NEMA 3R raintight and a removable steel plate 1/4 inch thick in the bottom for field drilling for conduit connections. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph "NAMEPLATES". Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

2.9.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper or aluminum and shall be tin or silver-plated throughout. Copper or aluminum bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B187 and ASTM B317. The sizes of buses and the details of panelboard construction shall meet or exceed the requirements of NEMA FB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

2.9.3 Components

Each branch circuit, and the main buses where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph "MOLDED CASE CIRCUIT BREAKERS". Circuit breakers of the same frame size and rating shall be interchangeable.
2.10 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Government Representative unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Government Representative.

a. Submit 6 copies of manufacturer's routine factory test procedures and production line tests for all motor control centers and switchboards, within a minimum of 14 days prior to the proposed date of tests. Notify the Government Representative a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Government Representative to be present at the tests.

b. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Government Representative. Submit 6 complete reproducible copies of the factory inspection results and 6 complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken.

c. Report shall be signed and dated by the Contractor's and the Government's Representatives. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Government Representative. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

2.10.1 Motor Control Centers Tests

2.10.1.1 Dielectric Tests

Each motor control center shall be completely assembled and given dielectric tests in accordance with NEMA ICS 1.

2.10.1.2 Operational Tests

The correctness of operation of each air circuit breaker or motor circuit protector and magnetic contactor and of all control devices, accessories and indicating lamps, shall be checked. These checks shall be made at rated voltage with power supplies to the main buses. All magnetic contactors shall also be checked for proper operation with power at 90 percent of rated voltage.

2.10.1.3 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the Contractor may submit design tests demonstrating that satisfactory short-circuit tests, as specified in NEMA ICS 2, have been made on a motor control center of similar type of construction and having the same available short circuit current at the motor terminals, including any motor contributions, as the motor control centers specified to be furnished under these specifications.
2.10.2 Switchboards Tests

2.10.2.1 Production Tests

Each switchboard shall be completely assembled and given applicable production tests for assembled switchgear as specified in NEMA PB 2.

2.10.2.2 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the Contractor may submit design tests demonstrating that satisfactory short-circuit tests have been made on a switchboard of similar type of construction and of the same short-circuit rating as the switchboards specified to be furnished under these specifications.

2.10.3 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

2.11 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph "SPARE PARTS".

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PART 3 EXECUTION (Not Applicable)

--- End of Section ---
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AUTOMATIC TRANSFER SWITCHES

08/11

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PART 2   PRODUCTS

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PART 3   EXECUTION

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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008 (2012) Transfer Switch Equipment

UL 508 (1999; Reprint Apr 2010) Industrial Control Equipment

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection Diagrams; G

Fabrication Drawings; G
QUALIFICATION TESTING

Provide certified independent laboratory test data for the furnished unit or an identical unit. Ensure tests meet the general use requirements of UL 508, Table 22.1. Subject the complete automatic transfer switch to a test as outlined in NEMA ICS 1, paragraph 109.5. One cycle of operation tests under the UL 508 test requirements consists of a transfer of load from the normal source to the emergency source and retransfer to the normal source. After the required number of test cycles, ensure the temperature rise of the contacts has not exceeded 149 degrees F. Test the switch operating time and the sense relay pickup and dropout times.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete automatic transfer switch system for use with engine-generator sets for standby power. Submit the following:

a. Connection diagrams showing the relations and connections of contacts, indicating lights, and terminal board by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another.

b. Fabrication drawings for contacts, indicating lights, terminal board enclosures, and accessories consisting of fabrication and assembly details to be performed in the factory.

c. Installation drawings for automatic transfer equipment in accordance
with the paragraph entitled, "Installation," of this section.

d. Equipment and performance data for automatic transfer equipment including life, test, system functional flows, safety features, and mechanical automated details.

2.1.1 Design Requirements

Ensure control and protective devices associated with automatic transfer switches are in accordance with Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

Provide an automatic transfer switch of the two-pole type for single-phase application, and three-pole type for three-phase application. Provide a solid neutral conductor connection for neutral transfer from normal source to emergency source.

2.1.2 Performance Requirements

Provide an automatic transfer switch capable of transferring the load from the normal power source to emergency power source, and from an emergency source to the normal power source. Locate switch where indicated. Provide a switch that is solenoid-operated, mechanically held, double-throw, rated for continuous duty, capable of transferring in 100 milliseconds or less, and conforming to the applicable requirements of UL 1008 and NFPA 70, Article 700, except as herein modified.

Ensure the automatic transfer switch is capable of being placed in either the normal or the emergency position.

2.2 FABRICATION

2.2.1 Short Circuit Withstand Current Rating

Provide switch with short-circuit current rating of 22 KA.

2.2.2 Self-Test Capability

Provide an automatic transfer switch with a control-circuit self-test feature capable of verifying the proper operation of the switch control circuit without moving the main contactor or causing discontinuity of service to the load. Include the following characteristics in the self-test circuit:

a. A key-operated switch that disconnects the main actuator and connects in its place, an indicator light. Design the key-operated switch to prevent removal of the key while the switch is in the self-test mode.

b. A power-failure simulator switch that removes voltage from the voltage-sensing devices so that emergency power activates the test light.

2.2.3 Enclosures

Provide automatic transfer switch enclosures with solid, unventilated, code-gage 14-gage, minimum sheet metal, NEMA 250, Type 1, with manufacturer's standard finish.
2.3 COMPONENTS

2.3.1 Contacts

Provide main contacts with a wiping-action silver alloy that, when rated for operation at 50 amperes or greater, are protected against arcing. Ensure auxiliary contacts and control transfer relay contacts have a minimum continuous current rating of not less than 10-amperes inductive at 120 volts ac. Provide the following auxiliary contacts:

a. Generator-control contacts, normally open, that close on undervoltage or loss of normal power as specified, remaining closed until transfer back to normal power

b. Emergency-position contacts, normally open when the switch is in the normal position, that close when the switch is in the emergency position

c. Normal position contacts, normally closed when the switch is in the normal position, that open when the switch is in the emergency position

Use two pole auxiliary contacts.

Provide a test automatic transfer switch mounted selector switch with contacts rated for operation at 10 amperes.

Provide automatic transfer switch with overlapping neutral transfer contacts in addition to the two- or three-pole main bus contacts. Normal and emergency neutral are connected together only during the transfer and retransfer operation. They remain connected only until the power source contacts close/open to transfer from one source to the other. Ensure overlapping neutral transfer contacts connection time does not exceed 100 milliseconds.

2.3.2 Indicating Lights

Furnish automatic transfer switch with two indicating lamps. One light to indicate that the switch is operating on normal power, and the other light to indicate that the switch is operating on emergency power. Fuse each indicating circuit.

2.3.3 Terminal Board

Internally wire control devices, indicating lights, auxiliary contacts, and internal control devices or auxiliary switches to a common output terminal board. Wire the internal functions to facilitate remote connections or monitoring.

2.4 OPERATION

Monitor normal source voltage across phase lines by sensing devices. If the normal source voltage in phase drops to 90 percent or less for a timed period, the automatic transfer switch starts the emergency source and transfer the load to the emergency source when voltage and frequency reach rated values or, if the emergency source is on, verify voltage and frequency of the alternate source and transfer the load to the alternate source. Field adjust this time period from 1 to 30 seconds. Provide a voltage and frequency sensor relay to monitor rated values on the emergency side to prohibit transfer until the emergency source voltage and
frequency reach at least 95 percent of the required rating. Provide phase failure protection, with 65 to 70 percent drop and 92 to 95 percent voltage pickup ratings.

Furnish the automatic transfer switch with a time-delay feature, field adjustable from 2 to 30 minutes, that operates to delay automatic transfer back to normal power until the normal source voltage and frequency reach at least 95 percent of the rated voltage. However, if the emergency power fails, and the normal source is again available at 90 percent of the rated voltage, bypass the time-delay circuitry, and the load immediately transferred back to the normal source. Provide capability for manual transfer in either direction. Operate sensing relays without contact chatter or false response during voltage variations between dropout and pickup.

2.5 ACCESSORIES

Incorporate with the automatic transfer switch a 24-volt solid-state, high-and low-rate charger complete with rheostat and ammeter, to maintain the engine-generator cranking batteries in a fully charged condition.

Incorporate an engine-generator exerciser timer with the automatic transfer switch to permit weekly programming of engine-generator set test runs under load.

PART 3 EXECUTION

3.1 INSTALLATION

Install automatic transfer switch as indicated, and in accordance with the manufacturer's installation instructions. Fully align and install wall-mounted enclosures at the indicated mounting height using a minimum of six 3/8-inch bolts. Use of sheet metal screws or small machine screws is not permitted.

Submit listing of product installations for automatic transfer switches showing the manufacturer has successfully manufactured automatic transfer switches of the size specified for a minimum period of 10 years. Include on the list, purchaser, address of installation, service organization, and date of installation.

3.2 FIELD TESTING

Demonstrate the automatic transfer switch operates in accordance with the specification requirements in conjunction with the normal and emergency power sources.

-- End of Section --
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DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS

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PART 1   GENERAL

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Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


ASME INTERNATIONAL (ASME)

ASME B16.11  (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.3  (2011) Malleable Iron Threaded Fittings, Classes 150 and 300


ASME BPVC SEC IX  (2010) BPVC Section IX-Welding and Brazing Qualifications

ASME BPVC SEC VIII D1  (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8  (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)


ASTM A234 (2011a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service


ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


IEEE 404 (2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V

IEEE 48 (2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (2009) Pipe Hangers and Supports -
<table>
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<th>Standard</th>
<th>Description</th>
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<tbody>
<tr>
<td>MSS SP-80</td>
<td>(2008; Errata 2012) Bronze Gate, Globe, Angle and Check Valves</td>
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**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

<table>
<thead>
<tr>
<th>Standard</th>
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<tbody>
<tr>
<td>NEMA ICS 2</td>
<td>(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V</td>
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<tr>
<td>NEMA ICS 6</td>
<td>(1993; R 2011) Enclosures</td>
</tr>
<tr>
<td>NEMA MG 1</td>
<td>(2011; Errata 2012) Motors and Generators</td>
</tr>
<tr>
<td>NEMA PB 1</td>
<td>(2011) Panelboards</td>
</tr>
<tr>
<td>NEMA/ANSI C12.11</td>
<td>(2007) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)</td>
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**NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

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<th>Standard</th>
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<tr>
<td>NFPA 30</td>
<td>(2012; Errata 2011; Errata 2011) Flammable and Combustible Liquids Code</td>
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<tr>
<td>NFPA 37</td>
<td>(2010; TIA 10-1) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines</td>
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<tr>
<td>NFPA 70</td>
<td>(2011; Errata 2 2012) National Electrical Code</td>
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<tr>
<td>NFPA 99</td>
<td>(2012; TIA 11-1; TIA 11-2; Errata 12-1) Health Care Facilities Code</td>
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**SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)**

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<th>Standard</th>
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<tr>
<td>SAE ARP892</td>
<td>(1965; R 1994) DC Starter-Generator, Engine</td>
</tr>
<tr>
<td>SAE J537</td>
<td>(2011) Storage Batteries</td>
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**UNDERWRITERS LABORATORIES (UL)**

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<th>Standard</th>
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<tbody>
<tr>
<td>UL 1236</td>
<td>(2006; Reprint Jul 2011) Standard for Battery Chargers for Charging Engine-Starter Batteries</td>
</tr>
</tbody>
</table>
1.3 SYSTEM DESCRIPTION

a. Provide and install each engine-generator set complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule. Submit certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

b. Provide each engine-generator set consisting of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Sets shall be assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Provide a generator strip heater for moisture control when the generator is not operating.

1.3.1 Engine-Generator Parameter Schedule

<table>
<thead>
<tr>
<th>ENGINE GENERATOR PARAMETER SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Load</td>
</tr>
<tr>
<td>Power Factor</td>
</tr>
<tr>
<td>Motor Starting kVA (maximum)</td>
</tr>
<tr>
<td>Maximum Speed</td>
</tr>
<tr>
<td>Engine-Generator Application</td>
</tr>
<tr>
<td>Engine Cooling Type</td>
</tr>
<tr>
<td>Heat Exchanger Type</td>
</tr>
<tr>
<td>Frequency Bandwidth percent steady state</td>
</tr>
<tr>
<td>Frequency Regulation (droop) (No load to full load)</td>
</tr>
<tr>
<td>Frequency Bandwidth percent (steady state)</td>
</tr>
</tbody>
</table>
ENGINE GENERATOR PARAMETER SCHEDULE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Regulation (No load to full load)</td>
<td>± 2 percent (max.)</td>
</tr>
<tr>
<td>Voltage Bandwidth (steady state)</td>
<td>± 2 percent</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Voltage</td>
<td>480 volts</td>
</tr>
<tr>
<td>Phases</td>
<td>3 Phase, Wye</td>
</tr>
<tr>
<td>Nonlinear Loads</td>
<td>20 kVA</td>
</tr>
<tr>
<td>Max Step Load Increase</td>
<td>100 percent of Service Load at 0.8 PF</td>
</tr>
<tr>
<td>Max Step Load Decrease (w/o shutdown)</td>
<td>100 percent of Service Load at 0.8 PF</td>
</tr>
<tr>
<td>Max Time to Start and be Ready to Assume Load</td>
<td>10 seconds</td>
</tr>
<tr>
<td>Max Summer Indoor Temp (Prior to Genset Operation)</td>
<td>90 degrees CF</td>
</tr>
<tr>
<td>Min Winter Indoor Temp (Prior to Genset Operation)</td>
<td>20 degrees CF</td>
</tr>
<tr>
<td>Min Winter Indoor Temp</td>
<td>60 degrees CF</td>
</tr>
<tr>
<td>Max Summer Outdoor Temp (Ambient)</td>
<td>95 degrees CF</td>
</tr>
<tr>
<td>Min Winter Outdoor Temp (Ambient)</td>
<td>20 degrees CF</td>
</tr>
<tr>
<td>Installation Elevation</td>
<td>20 above sea level</td>
</tr>
</tbody>
</table>

1.3.2 Output Capacity

Provide each generator set with power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph "Engine-Generator Parameter Schedule".

1.3.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.
1.3.4 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant, fully weather resistant, contain all set components, and provide ventilation to permit operation at rated load under secured conditions. Provide doors for access to all controls and equipment requiring periodic maintenance or adjustment. Provide removable panels for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph "SOUND LIMITATIONS".

1.3.5 Vibration Isolation

1.3.5.1 Vibration Limitations

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 6 mils (peak-peak RMS), with an overall velocity limit of 0.95 inches/seconds RMS, for all speeds through 110 percent of rated speed. The engine-generator set shall be provided with vibration-isolation in accordance with the manufacturer's standard recommendation. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, provide seismic restraints in accordance with the seismic parameters specified.

1.3.5.2 Torsional Analysis

Submit torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10 percent.

1.3.5.3 Performance Data

Submit vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Also submit a description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

1.3.6 Reliability and Durability

Submit documentation which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, and output power rating. Like generators are
of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detailed Drawings; G
Acceptance; G

SD-03 Product Data

Manufacturer's Catalog
Instructions
Experience
Field Engineer
Site Welding
General Installation
Site Visit

SD-05 Design Data

Sound Limitations
Generator
Integral Main Fuel Storage Tank
Day Tank
Power Factor
Heat Exchanger
Time-Delay on Alarms
Cooling System
Vibration Isolation

SD-06 Test Reports

Performance Tests
Onsite Inspection and Tests; G

SD-07 Certificates

Vibration Isolation
Prototype Tests
Reliability and Durability
Emissions
Sound limitations
Current Balance
Materials and Equipment
Factory Inspection and Tests
Inspections
Cooling System

SD-10 Operation and Maintenance Data
1.5 QUALITY ASSURANCE

1.5.1 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, the design, fabrication and installation shall conform to the code.

1.5.2 Site Welding

Weld structural members in accordance with Section 05 05 23 WELDING, STRUCTURAL. For all other welding, qualify procedures and welders in accordance with ASME BPVC SEC IX.

a. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1.

b. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. Notify the Government Representative 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical.

c. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record

d. Submit a letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their qualifications symbols.

1.5.3 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use. Submit a statement showing and verifying these requirements.

1.5.4 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets. Submit a letter listing the qualifications, schools, formal training, and experience of the field engineer.
1.5.5 Detailed Drawings

Submit detailed drawings showing the following:

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.

k. Panel layouts.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

1.6 DELIVERY, STORAGE AND HANDLING

Properly protect materials and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Protect stored items from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.7 MAINTENANCE SERVICE

Submit the operation and maintenance manuals and have them approved prior to commencing onsite tests.

1.7.1 Operation Manual

Provide three 3 copies of the manufacturers standard operation manual. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 8-1/2 by 11 inch plastic pockets with reinforced holes. The manual shall include:

a. Step-by-step procedures for system startup, operation, and shutdown;
b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;

c. Procedures for interface and interaction with related systems to include automatic transfer switches.

1.7.2 Maintenance Manual

Provide three copies of the manufacturer's standard maintenance manual. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes. The manual shall include:

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components listed in paragraph "GENERAL REQUIREMENTS".

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7.3 Extra Materials

Provide two sets of special tools and two sets of filters required for maintenance. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Supply two complete sets of filters in a suitable storage box in addition to filters replaced after testing.

PART 2 PRODUCTS

2.1 NAMEPLATES

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat exchangers (other than base-mounted).

<table>
<thead>
<tr>
<th>Engines</th>
<th>Relays</th>
</tr>
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<tbody>
<tr>
<td>Generators</td>
<td>Day tanks</td>
</tr>
<tr>
<td>Transformers (CT &amp; PT)</td>
<td>Regulators</td>
</tr>
<tr>
<td>Pumps and pump motors</td>
<td>Governors</td>
</tr>
<tr>
<td>Generator Breaker</td>
<td>Economizers</td>
</tr>
</tbody>
</table>
Heat exchangers (other than base-mounted)

Where the following equipment is provided as a standard component by the diesel-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger                  Heaters
Exhaust mufflers                 Exciters
Switchgear                      Silencers
Battery

2.2 SAFETY DEVICES

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

2.3 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified. Submit a letter certifying that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

2.3.1 Circuit Breakers, Low Voltage

UL 489 and UL 489.

2.3.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

2.3.3 Instrument Transformers

NEMA/ANSI C12.11.

2.3.4 Pipe (Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)

ASTM A53, ASTM A106 or ASTM A135, steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

2.3.5 Pipe Flanges and Fittings

a. Pipe Flanges and Flanged Fittings: ASTM A181, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A234, Grade WPB or WPC, Class 150, or ASME B16.11, 3000 lb.


d. Valves: MSS SP-80, Class 150.
e. Gaskets: Manufacturers Standard.

2.3.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.3.7 Electrical Enclosures

2.3.7.1 General

NEMA ICS 6.

2.3.7.2 Panelboards

NEMA PB 1.

2.3.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed. AC motors larger than 1/2 Hp shall be of the squirrel cage induction type for standard voltage of 460 volts, 60 Hz volts three phase power. AC motors 1/2 Hp or smaller, shall be for standard voltage 115 volts, 60 Hz, single phase power.

2.3.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.4 ENGINE

Each engine shall operate on No. 2-D diesel conforming to ASTM D975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog data, which describes and depicts each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance. The engine shall be naturally aspirated, scavenged, supercharged or turbocharged. The engine shall be two- or four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.5 FUEL SYSTEM

The fuel system for each engine generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.5.1 Pumps

2.5.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall
supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.5.1.2 Auxiliary Fuel Pump

Auxiliary fuel pumps shall be provided to maintain the required engine fuel pressure, either required by the installation or indicated on the drawings. The auxiliary pump shall be driven by a dc electric motor powered by the starting/station batteries. The auxiliary pump shall be automatically actuated by a pressure detecting device.

2.5.2 Filter

A minimum of one full flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.5.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.

2.5.4 Integral Main Fuel Storage Tank

Each engine shall be provided with an integral main fuel tank. Each tank shall be factory installed and provided as an integral part of the diesel generator manufacturer's product. Each tank shall be provided with connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, and float switch assembly. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank shall be below the flash point of the fuel. Each engine-generator set provided with weatherproof enclosures shall have its tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.5.4.1 Capacity

Each tank shall have capacity to supply fuel to the engine for an uninterrupted 4-hour period at 100 percent rated load without being refilled.

2.5.4.2 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.5.4.3 Fuel Level Controls

Each tank shall have a float-switch assembly to perform the following functions:

a. Activate the "Low Fuel Level" alarm at 70 percent of the rated tank capacity.

b. Activate the "Overfill Fuel Level" alarm at 95 percent of the rated
2.5.4.4 Arrangement

Integral tanks may allow gravity flow into the engine. Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The fuel supply line from the tank to the manufacturer's standard engine connection shall be welded pipe.

2.5.5 Day Tank

Each engine shall be provided with a separate self-supporting day tank. Each day tank shall be provided with connections for fuel supply line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. Each engine-generator set provided with weatherproof enclosures shall have its day tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.5.5.1 Capacity, Standby

Each day tank shall have capacity to supply fuel to the engine for an uninterrupted 4-hour period at 100 percent rated load without being refilled, plus any fuel which may be returned to the main fuel storage tank. Submit calculations for the capacity of each day tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90 percent of the ultimate volume of the tank.

2.5.5.2 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self supporting day tanks shall be arranged to allow drainage into a 12 inch tall bucket.

2.5.5.3 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.5.5.4 Fuel Level Controls

Each day tank shall have a float-switch-assembly to perform the following functions:

a. Start the supply of fuel into the day tank when the fuel level is at the "Low" level mark, 75% of the rated tank capacity.

b. Stop the supply of fuel into the day tank when the fuel level is at 90 percent of the rated tank capacity.

c. Activate the "Overfill Fuel Level" alarm at 95 percent of the rated tank volume.
d. Activate the "Low Fuel Level" alarm at 70 percent of the rated tank Capacity.

e. Activate the automatic fuel supply shut-off valve located on the fill line of the day tank and shut down the fuel pump which supplies fuel to the day tank at 95 percent of the rated tank volume. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

2.5.5.5 Arrangement

Integral day tanks may allow gravity flow into the engine. Gravity flow tanks shall be provided with an internal or external valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The overflow connection and the fuel supply line for integral day tanks which do not rely upon gravity flow shall be arranged so that the highest possible fuel level is below the fuel injectors. The fuel supply line from the day tank to the manufacturer's standard engine connection shall be welded pipe.

2.6 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.6.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.6.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.7 COOLING SYSTEM

Each engine cooling system shall operate automatically while the engine is running. Each cooling system shall be sized for the maximum summer indoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted.
a. The maximum and minimum allowable inlet temperatures of the cooling air.
b. The maximum allowable temperature rise in the cooling air across the engine.
c. The minimum allowable inlet fuel temperature.

2.7.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.7.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in accordance with paragraph "SUBMITTALS" for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application. Submit manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

2.7.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via oversizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Government Representative. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psi. Each heat exchanger shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes. One tapped hole in the heat exchanger shall be equipped with a drain cock, the rest shall be plugged.

2.7.3 Expansion Tank

The cooling system shall include an air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The tank shall be suitable for an operating temperature of 250 degrees F and a working pressure of 125 psi. The tank shall be constructed of welded steel, tested and stamped in accordance with ASME BPVC SEC VIII D1 for the stated working pressure. A bladder type tank shall not be used. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installation.

2.7.4 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.
2.8 SOUND LIMITATIONS

The noise generated by the diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured in a free field at a radial distance of 22.9 feet at 45 degrees apart in all directions. Submit data to demonstrate compliance with these sound limitation requirements. Also submit certification from the manufacturer stating that the sound emissions meet the specification.

<table>
<thead>
<tr>
<th>Frequency Band (Hz)</th>
<th>Maximum Acceptable Pressure Level (Decibels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>90</td>
</tr>
<tr>
<td>63</td>
<td>90</td>
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<tr>
<td>125</td>
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<td>90</td>
</tr>
<tr>
<td>4000</td>
<td>90</td>
</tr>
<tr>
<td>8000</td>
<td>90</td>
</tr>
</tbody>
</table>

2.9 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph "SOUND LIMITATIONS". A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be rubber.

2.10 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

2.10.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted
seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.10.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph "SOUND LIMITATIONS". The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.10.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph "THERMAL INSULATION" and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity operated, self-closing, rain cover.

2.11 EMISSIONS

Submit a certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

2.12 STARTING SYSTEM

The starting system for engine generator sets used in non-emergency applications shall be as follows.

2.12.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for fully automatic starting in accordance with paragraph "AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION". Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.12.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three
cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.12.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP892.

2.12.4 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, and spacers. The battery shall be in accordance with SAE J537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid type, with sufficient capacity, at the minimum outdoor winter temperature specified to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.12.5 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition. An ammeter shall be provided to indicate charging rate. A timer shall be provided for the equalize charging rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.12.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

2.12.6.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of -25 degrees F.

2.12.6.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

2.13 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100 percent of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from
90 to 110 percent of the rated speed/frequency, over a steady state load range of zero to 100 percent of rated capacity.

2.14 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type. Submit each generator KW rating and short circuit capacity (both symmetric and asymmetric).

2.14.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases. Submit manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125 percent of rated speed without vibration or damage.

2.14.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.14.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10 percent. The RMS of all harmonics shall be less than 5.0 percent and that of any one harmonic less than 3.0 percent at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE 519.

2.15 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300 percent for peak inverse voltage and forward current ratings for all operating conditions, including 110 percent generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.
2.16 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100 percent of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110 percent of the rated voltage over the steady state load range of zero to 100 percent of rated output capacity. Regulation drift shall not exceed plus or minus 0.5 percent for an ambient temperature change of 36 degrees F. The voltage regulator shall have a maximum droop of 2 percent of rated voltage over a load range from 0 to 100 percent of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.17 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. Molded case breakers shall be provided with shunt trip. Surge protection shall be provided for each phase of the generator, to be mounted at the generator terminals.

2.17.1 Panelboards

Panelboards shall be metal-enclosed, general purpose, 3-phase, 4-wire, 600 volt rated, with neutral bus and continuous ground bus, conforming to NEMA PB 1 and UL 891. Neutral bus and ground bus capacity shall be full capacity. Enclosure designs, construction, materials and coatings shall be suitable for the application and environment. Bus continuous current rating shall be at least equal to the generator rating and correspond to UL listed current ratings specified for panelboards and switchboards. Current withstand rating (short circuit rating) shall match the generator capacity. Buses shall be copper.

2.18 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.18.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 10 feet. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.
2.18.2 Visual Alarm Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously light upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.18.3 Alarms and Action Logic

2.18.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.18.3.2 Problem

Activation of the visual signal shall be accomplished.

2.18.4 Local Alarm Panel

Provide a local alarm panel with the following shutdown and alarm functions in accordance with NFPA 99 and NFPA 110 level 1 and 2 and including the listed Corps of Engineers requirements, mounted either on or adjacent to the engine generator set.

<table>
<thead>
<tr>
<th>Device/Condition/Function</th>
<th>What/Where/ Sizes</th>
<th>NFPA 99</th>
<th>NFPA 110 Level 1</th>
<th>NFPA 110 Level 2</th>
<th>Corps of Engineers Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutdowns W/Alarms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High engine temperature</td>
<td>Automatic/ jacket water/ cylinder</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD VA</td>
</tr>
<tr>
<td>Low lube-oil pressure</td>
<td>Automatic/ pressure/ level</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD VA</td>
</tr>
<tr>
<td>Overspeed shutdown $ alarm</td>
<td>(110% (+ 2%) of rated speed)</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD VA</td>
</tr>
<tr>
<td>Overcrank failure to start</td>
<td>Automatic/ Failure to start</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td></td>
</tr>
<tr>
<td>Air shutdown damper (200-600 kW)</td>
<td>When used</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td></td>
</tr>
<tr>
<td>Device/Condition/Function</td>
<td>What/Where/ Sizes</td>
<td>NFPA 99 Level 1</td>
<td>NFPA 110 Level 1</td>
<td>NFPA 110 Level 2</td>
<td>Corps of Engineers Required</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Day tank overfill limit indication &amp; transfer pump shutdown (95% volume)</td>
<td>Automatic/ Day Tank/ Level</td>
<td>SD/CP VA</td>
<td>SD/CP VA</td>
<td>SD VA</td>
<td>SD/OPA (Pump)</td>
</tr>
<tr>
<td>Red emergency stop switch</td>
<td>Manual switch</td>
<td></td>
<td></td>
<td></td>
<td>SD VA</td>
</tr>
<tr>
<td>Failure to crank</td>
<td>Corps of Engineers Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integral Main Fuel Tank low fuel limit</td>
<td>Corps of Engineers Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integral Main Fuel Tank low fuel limit Device/Condition/indication (70% volume remaining)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low lube-oil pressure</td>
<td>Pressure/ level</td>
<td>CP VA</td>
<td>CP VA</td>
<td>CP VA</td>
<td>CP VA</td>
</tr>
<tr>
<td>Low fuel level</td>
<td>Main tank, 3 hours remaining</td>
<td>VA/AA</td>
<td>CP VA</td>
<td>CP VAO</td>
<td></td>
</tr>
<tr>
<td>High fuel level</td>
<td>Integral Main Fuel Storage Tank 95% Volume</td>
<td></td>
<td></td>
<td></td>
<td>CP VA</td>
</tr>
<tr>
<td>Low coolant</td>
<td>Jacket water</td>
<td>CP/VA</td>
<td>CP/VA</td>
<td>CP/VA</td>
<td></td>
</tr>
<tr>
<td>Pre-high temperature</td>
<td>Jacket water/cylinder</td>
<td>CP/VA</td>
<td>CP/VA</td>
<td>CP VAO</td>
<td>CP/VA</td>
</tr>
<tr>
<td>Pre-low lube-oil pressure</td>
<td></td>
<td>CP/VA</td>
<td></td>
<td></td>
<td>CP/VA</td>
</tr>
<tr>
<td>High battery voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CP/VA</td>
</tr>
<tr>
<td>Low battery voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CP VAO</td>
</tr>
</tbody>
</table>
For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

Submit the magnitude of monitored values which define alarm or action setpoints, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

2.18.6 Remote Alarm Panel

A remote alarm panel shall be provided in accordance with NFPA 99 and NFPA 110 and as follows:

<table>
<thead>
<tr>
<th>Device/Condition/Function</th>
<th>What/Where/Size</th>
<th>NFPA 99</th>
<th>NFPA 110 Level 1</th>
<th>NFPA 110 Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote annunciator panel</td>
<td>Battery powered</td>
<td></td>
<td>Alarms</td>
<td></td>
</tr>
<tr>
<td>Device/ Condition/ Function</td>
<td>What/Where/Size</td>
<td>NFPA 99</td>
<td>NFPA 110 Level 1</td>
<td>NFPA 110 Level 2</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------</td>
<td>---------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Loads on genset</td>
<td>VA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery charger malfunction</td>
<td>VA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low lube-oil</td>
<td>Pressure/level</td>
<td>VA/AA</td>
<td>AA</td>
<td>AAO</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>Jacket water</td>
<td>VA/AA</td>
<td>AA</td>
<td>AAO</td>
</tr>
<tr>
<td>High Temperature</td>
<td>Jacket water/cylinder</td>
<td>VA/AA</td>
<td>AA</td>
<td>AAO</td>
</tr>
<tr>
<td>Low fuel level</td>
<td>Main tank, 3 hr remaining</td>
<td>VA/AA</td>
<td>AA</td>
<td>AAO</td>
</tr>
<tr>
<td>Overcrank</td>
<td>Failure to start</td>
<td>VA/AA</td>
<td>AA</td>
<td>AAO</td>
</tr>
<tr>
<td>Overspeed</td>
<td></td>
<td>VA/AA</td>
<td>AA</td>
<td>AAO</td>
</tr>
<tr>
<td>Pre-high temperature</td>
<td>Jacket water/cylinder</td>
<td>AA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control switch not in AUTO</td>
<td></td>
<td>AA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common alarm contacts for local &amp; remote common alarm</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audible alarm silencing switch</td>
<td></td>
<td>X</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Air shutdown damper</td>
<td>When used</td>
<td>AA</td>
<td>AAO</td>
<td></td>
</tr>
<tr>
<td>Common fault alarm</td>
<td></td>
<td>AA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Symbology Key**

- X Required
- SD Shut Down
- CP On Control Panel
- VA Visual Alarm
- AA Audible Alarm
- O Optional

**2.19 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION**

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.
2.19.1 Controls

A local control panel shall be provided with controls in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine generator set. A remote control panel shall be provided with devices as indicated.

<table>
<thead>
<tr>
<th>Device/ Condition/ Function</th>
<th>Corps Requirement</th>
<th>NFPA 110 Level 1</th>
<th>NFPA 110 Level 2</th>
<th>MFG Offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch: run/start - off/set - auto</td>
<td>CP</td>
<td></td>
<td></td>
<td>CP/STD</td>
</tr>
<tr>
<td>Emergency stop switch &amp; alarm</td>
<td>CP</td>
<td></td>
<td></td>
<td>CP/STD</td>
</tr>
<tr>
<td>Lamp test/indicator test</td>
<td>CP</td>
<td>CP VA</td>
<td>CP VA</td>
<td>CP/STD</td>
</tr>
<tr>
<td>Common alarm contacts/ fault relay</td>
<td>X</td>
<td>X</td>
<td></td>
<td>CP/O</td>
</tr>
<tr>
<td>Panel lighting</td>
<td>CP</td>
<td></td>
<td></td>
<td>CP/STD</td>
</tr>
<tr>
<td>Audible alarm &amp; silencing/reset switch</td>
<td>CP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage adjust for voltage regulator</td>
<td>CP</td>
<td></td>
<td></td>
<td>CP/STD</td>
</tr>
<tr>
<td>Pyrometer display w/selector switch</td>
<td>CP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote emergency stop switch</td>
<td>CP VA</td>
<td>CP VA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote fuel shutoff switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote lube-oil shutoff switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.19.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices in accordance with NFPA 110 level 1 and mounted either on or adjacent to the engine generator set. A remote control panel shall be provided with devices as indicated fully redundant to the local control panel.

<table>
<thead>
<tr>
<th>Device/ Condition/ Function</th>
<th>Corps Requirement</th>
<th>NFPA 110 Level 1</th>
<th>NFPA 110 Level 2</th>
<th>MFG Offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genset Status &amp; Metering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device/ Condition/ Function</td>
<td>Corps Requirement</td>
<td>NFPA 110 Level 1</td>
<td>NFPA 110 Level 2</td>
<td>MFG Offering</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Genset supplying load</td>
<td>CP VA</td>
<td>CP VA</td>
<td>CP VAO</td>
<td></td>
</tr>
<tr>
<td>System ready</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Engine oil pressure</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Engine coolant temperature</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Engine RPM (Tachometer)</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Engine run hours</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Pyrometer display w/selector switch</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>AC volts (generator), 3-phase</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>AC amps (generator), 3-phase</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Generator frequency</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Phase selector switches (amps &amp; volts)</td>
<td>CP</td>
<td>CP</td>
<td>CP/STD</td>
<td></td>
</tr>
<tr>
<td>Watts/kW</td>
<td>CP</td>
<td></td>
<td>CP/VA-O</td>
<td></td>
</tr>
<tr>
<td>Voltage Regulator Adjustment</td>
<td>CP</td>
<td></td>
<td>CP/VA-O</td>
<td></td>
</tr>
</tbody>
</table>

**Symbology Key:**

- **CP**  On Control Panel
- **VA**  Visual Alarm
- **AA**  Audible Alarm
- **O**  Optional
- **STD**  Manufacturers Standard Offering

**2.20 PANELS**

Each panel shall be of the type necessary to provide specified functions. Panels shall be mounted on the engine generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of instruments shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Panels except the remote alarm panel can be combined into a single panel.

**2.20.1 Enclosures**

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms which are keyed alike.
2.20.2  Analog

Analog electrical indicating instruments shall be in accordance with ANSI C39.1 with semiflush mounting. Switchgear, and control-room panel-mounted instruments shall have 250 degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range shall be minus 4 to plus 130 degrees F. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz and amps.

2.20.3  Electronic

Electronic indicating instruments shall be true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 2 percent for unit mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 4 to plus 130 degrees F. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 1/2 inch.

2.20.4  Parameter Display

Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.

2.20.5  Exerciser

The exerciser shall be in accordance with Section 26 36 00.00 10 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.21  SURGE PROTECTION

Electrical and electronic components shall be protected from, or designed to withstand the effects of surges from switching and lightning.

2.22  AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

2.22.1  Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 26 36 00.00 10 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.
2.22.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 26 36 00.00 10 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.23 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

2.24 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of synchronous vibration of the engine and generator, and shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.25 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.26 FACTORY INSPECTION AND TESTS

Perform factory inspection and tests on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests. Submit a certification that each engine generator set passed the factory tests and inspections and a list of the test and inspections.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform a Site Visit to verify details of the work. Submit a site visit letter stating the date the site was visited and listing discrepancies found and advise the Government Representative in writing of any discrepancies before performing any work.

3.2 GENERAL INSTALLATION

Submit a complete copy of the manufacturer's installation procedures. A detailed description of the manufacturer's recommended break-in procedure.

Provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Configure installation of pipe, duct, conduit, and ancillary equipment to facilitate easy removal and replacement of major
3.3  PIPING INSTALLATION

3.3.1  General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturer's standard connection is threaded. Except as otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors, and openings to permit thermal expansion and contraction without damage to joints or hangers, and with a 1/2 inch drain valve at each low point.

3.3.2  Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 7 feet on center for pipes 2 inches in diameter or less, not more than 12 feet on center for pipes larger than 2 inches but no larger than 4 inches, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Supports shall be provided at pipe bends or change of direction.

3.3.2.1  Ceiling and Roof

Exhaust piping shall be supported with appropriately sized type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized type 1 clevis and threaded rods.

3.3.2.2  Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized type 33 brackets with the appropriate ceiling and roof pipe supports.

3.3.3  Flanged Joints

Flanges shall be 125 pound type, drilled, and of the proper size and configuration to match equipment and diesel-engine connections. Gaskets shall be factory cut in one piece 1/16 inch thick.

3.3.4  Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

3.3.5  Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be 1/2 inch, and where pipes pass...
through combustible materials, 1 inch larger than the outside diameter of the passing pipe or pipe covering.

3.4 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. For vibration isolation, flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets; metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor; and terminations of conductors on the engine generator set shall be crimp-type terminals or lugs. Submit manufacturer's standard certification that prototype tests were performed for the generator model proposed.

3.5 FIELD PAINTING

Field painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6 ONSITE INSPECTION AND TESTS

3.6.1 Submittal Requirements

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 7 days prior to beginning tests.

c. Six 6 copies of the onsite test data described below in 8-1/2 by 11 inch 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 8-1/2 by 11 inches minimum), showing all grid lines, with full resolution.

(1) A description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) The parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of all adjustments made.
3.6.2 Test Conditions

3.6.2.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Electrical measurements shall be performed in accordance with IEEE 120. Definitions and terms are in accordance with IEEE Stds Dictionary. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE 1.

3.6.2.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with the power factor specified in the engine generator set parameter schedule. Submit generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

3.6.2.3 Contractor Supplied Items

Provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.6.2.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments of precision and accuracy greater than the tested items. Test instrument accuracy shall be at least as follows: current, 1.5 percent; voltage, 1.5 percent; real power, 1.5 percent; reactive power, 1.5 percent; power factor, 3 percent; frequency, 0.5 percent. Test instruments shall be calibrated by a recognized standards laboratory within 90 days prior to testing.

3.6.2.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance in authorized by the Government Representative. Field testing shall be performed in the presence of the Government Representative. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.
3.6.3 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.6.3.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine generator set shall be pressure tested with air pressure at 150 percent of the maximum anticipated working pressure, but in no case less than 150 psig, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.6.3.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

(1) \[ R \text{ in megohms} = \frac{(\text{rated voltage in kV} + 1) \times 1000}{\text{length of cable in feet}} \]

(2) Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

b. Medium-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the main disconnect switch. After insulation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 74/ICEA S-93-639 for the particular type of cable installed, except that 28kV and 35kV insulation test voltages shall be in accordance with either AEIC CS8 or AEIC CS8 as applicable, and shall not exceed the recommendations of IEEE 404 for cable joints and IEEE 48 for cable terminations unless
the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

c. Ground-Resistance Tests. The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

(1) Single rod electrode - 25 ohms.
(2) Multiple rod electrodes - 25 ohms.
(3) Ground mat - 25 ohms.

d. Circuit breakers and switchgear shall be examined and tested in accordance with manufacturer's published instructions for functional testing.

3.6.4 Inspections

The following inspections shall be performed jointly by the Government Representative and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented and submitted as a letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use. Present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)
21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

3.6.5 Safety Run Tests

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.
h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.

l. Verify proper operation of the governor and voltage regulator.

m. Verify proper operation and setpoints of gauges and instruments.

n. Verify proper operation of ancillary equipment.

o. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.

s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of service load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and
reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100 percent of service load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping. The measurements should comply with the paragraph "SOUND LIMITATIONS". If a sound limiting enclosure is not provided, the muffler and air intake silencer shall be modified or replaced as required to meet the sound limitations of this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intact silencer, notify the Government Representative and provide a recommendation for meeting the sound limitations.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.7 ONSITE TRAINING

Conduct training course for operating staff as designated by the Government Representative. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change, oil filter change, and air filter change.

3.8 FINAL INSPECTION AND TESTING

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the maximum step load increase to 100 percent of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.
e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.9 MANUFACTURER'S FIELD SERVICE

The engine generator-set manufacturer shall furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.10 INSTRUCTIONS

Two sets of instructions shall be typed in 8 1/2 x 11 inches format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. The binders shall be placed as directed by the Government Representative. The instructions shall be in place prior to acceptance of the engine generator set installation. First set of instructions shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.11 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

Submit drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Revise layout drawings to reflect the as-built conditions and submit them with the as-built drawings.

-- End of Section --
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DIVISION 26 - ELECTRICAL

SECTION 26 36 00.00 10

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH

10/07

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PART 1   GENERAL

1.1   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


NEMA ICS 2   (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload
Relays Rated 600 V

NEMA ICS 4 (2010) Terminal Blocks
NEMA ICS 6 (1993; R 2011) Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008 (2012) Transfer Switch Equipment
UL 1066 (2012) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Detail Drawings; G
   Equipment; G
   Installation; G

SD-03 Product Data
   Material
   Equipment

SD-06 Test Reports
   Testing

SD-07 Certificates
   Equipment
   Material
   Switching Equipment

SD-10 Operation and Maintenance Data
   Switching Equipment
   Instructions
1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Submit schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

1.4.2 Switching Equipment

Upon request, manufacturer shall provide notarized letter certifying compliance with requirements of this specification, including withstand current rating (WCR). Submit evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Submit an operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Manual shall include simplified wiring and control diagrams for system as installed.

1.5 SITE CONDITIONS

ATS shall be suitable for prolonged performance under following service conditions:

a. Altitude: 100 feet above mean sea level.

b. Relative Humidity: 90 percent maximum, continuous.

c. Temperature: Minus 0 to 95 degrees F.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide material and equipment which are standard products of a manufacturer regularly engaged in manufacturing the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit list of proposed equipment and material, containing a description of each separate item, and certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Government Representative's opinion, reasonably convenient to the site.
2.2 NAMEPLATE

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

2.3 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in emergency systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41.1, IEEE C62.41.2, IEEE 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10 Part 2, UL 1008 and UL 1066. ATS shall conform to NFPA 110.

To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of ATS system. ATS shall have following characteristics:

a. Voltage: 480 volts ac.

b. Number of Phases: Three.

c. Number of Wires: Three.

d. Frequency: 60 Hz.

e. Poles: Three switched and solid neutral.

f. ATS WCR: Rated to withstand short-circuit current of 65,000 amperes, RMS symmetrical.

g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.

h. Main Contacts: Contacts shall have silver alloy composition.

2.3.1 Override Time Delay

Provide adjustable time delay to override monitored source deviation from 0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to emergency source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of nominal.

2.3.2 Transfer Time Delay

Time delay before transfer to emergency power source shall be adjustable from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor
frequency and voltage of emergency power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.3.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of emergency power source, provided that normal supply has been restored.

2.3.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

2.3.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable. The generator exerciser shall be selectable between load transfer and engine run only, and shall have a fail-safe feature that will retransfer the ATS to normal during the exercise period.

2.3.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 10 amperes at 120 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to emergency source.

2.3.7 Supplemental Features

ATS shall be furnished with the following:

a. Engine start contact.

b. Emergency source monitor.

c. Test switch to simulate normal power outage.

d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.

e. Time delay bypass switch to override return time delay to normal.


g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.
2.3.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.3.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to emergency power source, regardless of condition of normal source. If emergency source fails and normal source is available, ATS shall automatically retransfer to normal source.

2.3.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL.

2.3.11 Red Indicating Light

A red indicating light shall supervise/provide emergency power source switch position indication and shall have a nameplate engraved EMERGENCY.

2.4 BY-PASS/ISOLATION SWITCH (BP/IS)

2.4.1 Design

Bypass/isolation switch (BP/IS) shall permit load by-pass to either normal emergency power source and complete isolation of associated ATS, independent of ATS operating position. BP/IS and associated ATS shall be products of same manufacturer and shall be completely interconnected and tested at factory and at project site as specified. BP/IS shall be manufactured, listed, and tested in accordance with paragraph "AUTOMATIC TRANSFER SWITCH (ATS)" and shall have electrical ratings that exceed or equal comparable ratings specified for ATS. Operating handles shall be externally operated and arranged so that one person can perform the bypass and isolation functions through the operation of a maximum of two handles within 5 seconds. The ATS shall have provisions for locking in the isolation position. Handle for manual operation shall be permanently attached to operating mechanism. BP/IS operation shall be accomplished without disconnecting switch load terminal conductors. Isolation handle positions shall be marked with engraved plates or other approved means to indicate position or operating condition of associated ATS, as follows:

a. Indication shall be provided to show that ATS section is providing power to the load.

b. Indication shall be provided of ATS isolation. The ATS controls shall remain functional with the ATS isolated or in bypass mode to permit monitoring of the normal power source and automatic starting of the generator in the event of a loss of the normal power source. In the isolated mode, the bypass section shall be capable of functioning as a manual transfer switch to transfer the load to either power source. The ATS shall be capable of undergoing functional operation testing without service interruption. The ATS may also be completely removed from the enclosure, if required for maintenance or repair,
while the bypass section continues to power the load.

2.4.2 Switch Construction

Bypass/isolation switch shall be constructed for convenient removal of parts from front of switch enclosure without removal of other parts or disconnection of external power conductors. Contacts shall be as specified for associated ATS, including provisions for inspection of contacts without disassembly of BP/IS or removal of entire contact enclosure. To facilitate maintenance, manufacturer shall provide instructions for determination of contact integrity. BP/IS and associated ATS shall be interconnected with suitably sized copper bus bars silver-plated at each connection point, and braced to withstand magnetic and thermal forces created at WCR specified for associated ATS.

2.5 ENCLOSURE

ATS and accessories shall be installed in floor-mounted, ventilated NEMA ICS 6, Type 1, smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Intake vent shall be screened and filtered. Exhaust vent shall be screened. Door shall have suitable hinges, locking handle latch, and gasketed jamb. Thermostatically controlled heater shall be provided within enclosure to prevent condensation over temperature range stipulated in paragraph "SERVICE CONDITIONS". Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from top and bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copper conductors shown.

2.5.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

2.5.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.
2.6 TESTING

Submit a description of proposed field test procedures, including proposed
date and steps describing each test, its duration and expected results,
not less than two weeks prior to test date. Submit certified factory and
field test reports, within 14 days following completion of tests. Reports
shall be certified and dated and shall demonstrate that tests were
successfully completed prior to shipment of equipment.

2.6.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with
UL 1008. In addition, factory tests shall be performed on each ATS as
follows:

a. Insulation resistance test to ensure integrity and continuity of
   entire system.

b. Main switch contact resistance test.

c. Visual inspection to verify that each ATS is as specified.

d. Mechanical test to verify that ATS sections are free of mechanical
   hindrances.

e. Electrical tests to verify complete system electrical operation
   and to set up time delays and voltage sensing settings.

2.6.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

2.7 FACTORY TESTING (MEDICAL FACILITIES)

2.7.1 Viewing Ports

ATS and BP/IS switches shall be of draw-out construction. Viewing ports
to inspect the contacts without requiring disassembly shall be provided.

2.7.2 Operating Handles

The operating handles shall be externally operated, and designed and
constructed not to stop in an intermediate or neutral position during
operation, but shall permit load by-pass and transfer switch isolation in
no more than two manual operations which can be performed by one person in
5 seconds or less. The transfer speed will be independent of the
operational speed of the switch handle or handles.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved
manufacturer's instructions. Submit dimensioned plans, sections and
elevations showing minimum clearances, weights, and conduit entry
provisions for each ATS.
3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door. Submit 6 copies of operating and 6 copies of maintenance manuals listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Advise the Government Representative not less than 5 working days prior to scheduled date for site testing, and provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.

b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.

d. Low phase-to-ground voltage shall be simulated for each phase of normal source.

e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

f. Manual and automatic ATS and BP/IS functions shall be verified.

-- End of Section --
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DIVISION 26 - ELECTRICAL

SECTION 26 42 00.00 12

CATHODIC PROTECTION

11/08

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PART 3   EXECUTION

3.1  BONDING, I AND T-TYPE FLOODWALL
3.2  BOND CABLES

-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SCOPE

The work covered by this section consists of furnishing all plant, labor, material, and equipment required to electrically bond the piling as shown on the drawings and as specified herein to permit installation of a cathodic protection system.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


1.4  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Bond Cables

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

1.5  QUALITY CONTROL

1.5.1  General

The Contractor shall establish and maintain quality control for bonding operations to assure compliance with contract specifications and maintain
records of his quality control for all construction operations including, but not limited to, the installation of bond cables.

1.5.2 Reporting

The original and two copies of these records and tests, as well as the records of corrective action taken, shall be furnished to the Government daily. The format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2 PRODUCTS

2.1 BONDING

2.1.1 Reinforcing Bar

A No. 6 reinforcing bar shall be used for electrically bonding sheet piles.

2.1.2 Bond Cables

Catalogue cuts of the bond cables shall be submitted to the Government Representative. Bond cables shall be cathodic protection, type CPS cables, 7-strand, #4 AWG, Class B, uncoated annealed copper conforming to ASTM B 3 and ASTM B 8. Insulation shall be black, high molecular weight polyethylene. Insulation wall thickness shall be a minimum of 11.0 mils.

PART 3 EXECUTION

3.1 BONDING, I AND T-TYPE FLOODWALL

The sheet piles shall be electrically bonded together with a No. 6 reinforcing bar as shown on the drawings and bond cables as indicated in paragraph "BOND CABLES." The sheet pile of the T-type wall shall be bonded to the sheetpile wall with bond cables.

3.2 BOND CABLES

Bond cables shall be welded to the piling using an exothermic type process. Welded joints shall be coated with Scotchcast Electrical Insulating Resin, or approved equal, splicing epoxy to obtain a moisture proof joint. The welding process shall be such that the heat of welding will not damage the insulation on the wire. The welding process shall be the Cadweld process of Erico Products, Inc., or an approved equal. Epoxy shall completely cover welded joints and extend 2 inches over cable insulation.

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SECTION 26 51 00

INTERIOR LIGHTING

07/07

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SECTION 26 51 00

INTERIOR LIGHTING

07/07

PART 1  GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


ASTM INTERNATIONAL (ASTM)

ASTM A1008  (2012) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened


ASTM A653  (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


CALIFORNIA ENERGY COMMISSION (CEC)


ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES HB-10  (2011) IES Lighting Handbook
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<td>The Authoritative Dictionary of IEEE Standards Terms</td>
<td>2000</td>
<td>Archived</td>
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<td>IEEE C62.41.2</td>
<td>Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits</td>
<td>2002</td>
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<td>ANSI ANSLG C78.41</td>
<td>For Electric Lamps--Guidelines for Low-Pressure Sodium Lamps</td>
<td>2006</td>
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<td>ANSI ANSLG C78.42</td>
<td>For Electric Lamps: High-Pressure Sodium Lamps</td>
<td>2009</td>
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<td>ANSI C78.901</td>
<td>American National Standard for Electric Lamps -- Single Base Fluorescent Lamps--Dimensional and Electrical Characteristics</td>
<td>2005</td>
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<td>ANSI C82.4</td>
<td>American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)</td>
<td>2002</td>
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<td>NEMA 250</td>
<td>Enclosures for Electrical Equipment (1000 Volts Maximum)</td>
<td>2008</td>
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<td>NEMA ANSLG C82.11</td>
<td>Lamp Ballasts -- High-Frequency Fluorescent Lamp Ballasts</td>
<td>2011</td>
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<tr>
<td>NEMA C136.10</td>
<td>American National Standard for Roadway and Area Lighting Equipment--Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing</td>
<td>2010</td>
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<td>NEMA ICS 2</td>
<td>Standard for Controllers, Contactors, and Overload Relays Rated 600 V</td>
<td>2000</td>
<td>Errata 2005</td>
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<td>1993</td>
<td>R 2011</td>
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1.3 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.
1.5 SYSTEM DESCRIPTION

1.5.1 Lighting Control System

Provide lighting control system as indicated. Lighting control equipment shall include, if indicated: control modules, power packs, dimming ballasts, occupancy sensors, and light level sensors.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES HB-10, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures; G
Fluorescent electronic ballasts; G
Fluorescent lamps; G
High-intensity-discharge (HID) lighting fixtures; G
HID ballasts; G
High-pressure sodium (HPS) lamps; G
Low-pressure sodium lamps; G
Metal-halide lamps; G
Lighting fixtures; G
Incandescent lamps; G
Lighting contactor; G
Photocell switch; G
Exit signs; G
Emergency lighting equipment; G
Energy Efficiency

SD-06 Test Reports

Operating test
Submit test results as stated in paragraph entitled "Field Quality Control."
1.7 QUALITY ASSURANCE

1.7.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

1.7.2 Lighting Fixtures, Complete With Lamps and Ballasts

1.7.2.1 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

1.9 OPERATIONAL SERVICE

Coordinate with manufacturer for take-back program. Collect information from the manufacturer about maintenance agreement options, and submit to the Government Representative. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1598. Fluorescent fixtures shall have electronic ballasts.
2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, NEMA ANSLG C82.11, NFPA 70, and CEC Title 24 unless specified otherwise. Ballast shall be 100 percent electronic high frequency type with no magnetic core and coil components. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast factor shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

f. Ballast shall be UL listed Class P with a sound rating of "A."

g. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

h. Ballasts shall be programmed start unless otherwise indicated. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

i. Ballasts for compact fluorescent fixtures shall be programmed start.

j. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by ANSI ANSLG C78.81 and ANSI C78.901 as applicable.

k. Ballast shall be capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

l. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 20 percent (maximum).

b. Input wattage.
   1. 32 watts (maximum) when operating one F32T8 lamp
2. 62 watts (maximum) when operating two F32T8 lamps
3. 92 watts (maximum) when operating three F32T8 lamps
4. 114 watts (maximum) when operating four F32T8 lamps
c. Ballast efficacy factor.
   1. 2.54 (minimum) when operating one F32T8 lamp
   2. 1.44 (minimum) when operating two F32T8 lamps
   3. 0.93 (minimum) when operating three F32T8 lamps
   4. 0.73 (minimum) when operating four F32T8 lamps

2.1.1.2 F17T8 Lamp Ballast
a. Total harmonic distortion (THD): Shall be 25 percent (maximum).
b. Input wattage:
   1. 34 watts (maximum) when operating two F17T8 lamps.

2.1.1.3 T-5 Long Twin Tube Lamp Ballast
a. Input wattage:
   1. 45 watts (maximum) when operating one F40 T-5 lamps
   2. 74 watts (maximum) when operating two F40 T-5 lamps
   3. 105 watts (maximum) when operating three F40 T-5 lamps

2.1.1.4 F96T8 Lamp Ballast
a. Input wattage:
   1. 56 watts (maximum) when operating one F96T8 lamps
   2. 102 watts (maximum) when operating two F96T8 lamps

2.1.2 Fluorescent Lamps
a. T-8 rapid start lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.
b. T-8 rapid start lamp, 17 watt (maximum), nominal length of 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.
c. T-8 instant start lamp, 59 watts (maximum), nominal length of 96 inches, minimum CRI of 75, 5700 initial lumens, color temperature of 3500 K, and average rated life of 15,000 hours.
d. T-12 slim line lamps shall be rated 60 watts (maximum), 5750 initial lumens (minimum), 12,000 hours average rated life.
e. T-5, long twin tube fluorescent lamp, 40 watts (maximum), 3500, 22.6 inches maximum length, 20,000 hours average rated life, 3150 initial lumens, CRI of 80 (minimum), 2G11 Type base, 90 to 100 lumens/watt depending on wattage.

f. T-8, U shaped fluorescent lamp, 31 watts maximum, 2600 initial lumens (minimum), 3500 K, 75 CRI (minimum), 20,000 hours average rated life, 1.625 inch leg spacing.

g. Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life.

Average rated life is based on 3 hours operating per start.

2.1.3 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated, with a minimum CRI of 80.

2.1.3.1 Bare Bulb Retrofits

Replace 40-watt incandescent bulbs (495+ lumens) with 11- to 14-watt compact fluorescent bulbs (45+ lumens per watt). Replace 60-watt incandescent bulbs (900+ lumens) with 15- to 19-watt compact fluorescent bulbs (60+ lumens per watt). Replace 75-watt incandescent bulbs (1200+ lumens) with 20- to 25-watt compact fluorescent bulbs (60+ lumens per watt). Replace 100-watt incandescent bulbs (1750+ lumens) with 29-watt or greater compact fluorescent bulbs (60+ lumens per watt).

2.1.3.2 Reflector Type Bulb Retrofits

Replace 50-watt incandescent bulbs (550+ lumens) with 17- to 19-watt compact fluorescent bulbs (33+ lumens per watt). Replace 60-watt incandescent bulbs (675+ lumens) with 20- to 21-watt compact fluorescent bulbs (40+ lumens per watt). Replace 75-watt incandescent bulbs (875+ lumens) with 22-watt or greater compact fluorescent bulbs (40+ lumens per watt).

2.1.4 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp). Provide a clear polycarbonate protective sleeve with end caps, over lamp, with 95 percent (minimum) light transmission. The sleeve shall be rated to withstand the thermal profile of the lamp and ballast.

2.1.5 Air Handling Fixtures

Fixtures used as air handling registers shall meet requirements of NFPA 90A.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1598. Provide HID fixtures with tempered glass lenses when using metal-halide lamps.
2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type (minimum 90 percent). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 High-Pressure Sodium (HPS) Lamps

ANSI ANSLG C78.42 wattage as indicated. 150 watt lamps, if required, shall be 55 volt type.

2.2.3 Low-Pressure Sodium Lamps

ANSI ANSLG C78.41.

2.2.4 Metal-Halide Lamps

a. Single-ended, wattage as indicated, conforming to ANSI/ANSLG C78.43.

2.3 INCANDESCENT LIGHTING FIXTURES

Use of incandescent lamps and fixtures is prohibited, unless specifically indicated otherwise. UL 1598.

2.3.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.4 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.5 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one
at each end. Rods shall be a minimum 0.18 inch diameter.

2.6 FIXTURES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide fluorescent HID fixtures for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.7 SWITCHES

2.7.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.8 LIGHTING CONTACTOR

NEMA ICS 2, mechanically held contactor. Contacts shall be rated 600 volts, 30 amperes, and 3 poles. Coils shall be rated 120 volts. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor. Provide contactor with hand-off-automatic selector switch.

2.9 PHOTOCCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 volts ac, 60 Hz with single-throw contacts. Switch shall turn on at or below 3 footcandles and off at 2 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch:

a. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to NEMA C136.10, rated 1800 VA, minimum.

2.10 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type. Exit signs shall use no more than 5 watts.

2.10.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum). The light emitting diodes shall have rated lamp life of 70,000 hours (minimum).

2.11 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated.

2.11.1 Emergency Lighting Unit

Provide as indicated. Equip units with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage and 15 minute time delay feature for areas with HID lighting. Provide
integral self-testing module.

2.11.2 Fluorescent Emergency System

Each system shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Provide self-testing module integral to the fixture. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to the number of lamps shown for each system for 90 minutes at a minimum of 600 lumens per lamp output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency ballasts provided with fixtures containing solid-state ballasts shall be fully compatible with the solid-state ballasts.

2.12 SELF-TESTING MODULE

Self-testing module for exit signs and emergency lighting equipment shall perform the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

2.13 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.13.1 Wires

ASTM A641, galvanized regular coating, soft temper, 0.1055 inches in diameter (12 gage).

2.13.2 Wires, for Humid Spaces

ASTM A580, composition 302 or 304, annealed stainless steel 0.1055 inches in diameter (12 gage).

2.13.3 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653, with a light commercial zinc coating or ASTM A1008 with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.13.4 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.
2.14 EQUIPMENT IDENTIFICATION

2.14.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.14.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.15 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15 percent of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.
3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures shall be independently supported from the building structure by a minimum of four wires, straps or rods per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires, straps or rods per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires, straps or rods for lighting fixture support in this section.

3.1.3 Suspended Fixtures

Suspended fixtures shall be provided with 45 degree swivel hangers so that they hang plumb and shall be located with no obstructions within the 45 degree range in all directions. The stem, canopy and fixture shall be capable of 45 degree swing. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degree separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.4 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.1.4.1 Exit Signs

Wire exit signs on separate circuits and serve from a separate breaker. Signs shall have only one control, which shall be the separate breaker. Paint control device red and provide lockout.
3.1.5  Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Set adjustable window slide for 2 minimum footcandles photocell turn-on.

3.2  FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3  FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

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EMERGENCY LIGHTING
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PART 1  GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 70  (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 924  (2006; Reprint Feb 2011) Standard for Emergency Lighting and Power Equipment

1.3  ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3.1  Pre-Installation Meetings

No later than 30 days after contract award, submit installation drawings for the Central Emergency Lighting Systems indicating location of installed fixtures.

Submit Material, Equipment, and Fixture Lists showing manufacturer's style or catalog numbers, specification and drawing reference numbers, sample warranty, and fabrication site location. Also submit manufacturer's catalog data and Certificates of Conformance for the following items:

a.  Emergency Lighting Egress Units
b.  Central Emergency Lighting Systems

1.4  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Furnish emergency lighting units completely assembled with wiring and mounting devices, ready for installation at the locations indicated. Equip fixtures with lamps. Ensure emergency lighting units are suitable for operation on the ac supply circuit to which they are to be electrically connected.

2.1.1 Performance Requirements

Provide emergency lighting units conforming to UL 924 and NFPA 101.

2.2 MANUFACTURED UNITS

2.2.1 Emergency Lighting Egress Units

Provide complete self-contained emergency lighting units with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, indicator lights, on/off switch, and test switch, in accordance with UL 924 for Type I (emergency light set), Class I rechargeable storage-battery-powered unit, as indicated.

2.2.1.1 Batteries

Provide batteries rated not less than 6-12 volts. Provide batteries with the capacity and rating to supply the lamp load with maintained 87.5 percent power, minimum, for 1.5 hours, or the battery-lamp combination maintaining 60-percent, minimum, illumination. Provide maintenance-free lead acid type batteries, with a minimum normal life of 10 years.

2.2.1.2 Battery Charger

Include in battery charger a dry-type full-wave rectifier with two charging rates, one to automatically maintain the battery in a fully charged state under normal conditions and the other to automatically recharge the battery to a fully charged state within 12 hours after continuous discharge of 1-1/2 hours through the connected lamplload.

2.2.1.3 Unit Enclosure

Fabricate the unit enclosure from sheet steel not less than 20 gage.
Design of cover is to provide access to the battery and battery-charger compartments and have a full-length piano hinge and a latching device. Protect component parts within the enclosure from dust, moisture, and oxidizing fumes from the battery. Coat interior and exterior surfaces of enclosure with a corrosion-resistant gray baked-enamel finish.

2.2.1.4 Lampheads, Lamps, and Indicating Lights

Mount the lampheads on the top of the unit enclosure, or wall mount, except where otherwise indicated and fully adjustable in the horizontal and vertical planes. Provide steel lamp head assembly with chromium plating. Form the exterior housing of the lamp from cadmium-plated sheet steel.

Provide sealed-beam type lamps, PAR-36, rated not less than 18 watts at the specified dc voltage.

Mount an amber "ready-for-use on alternating current" indicating light, a red "recharging on alternating current" indicating light, and a momentary-contact pushbutton test switch on the cover of the unit enclosure. The amber light indicates, when illuminated, that the unit is electrically connected to the normal ac supply source and that the battery is fully charged. The red light indicates, when illuminated, that the battery is being recharged. The momentary-contact pushbutton test switch transfers the unit from normal supply to battery supply and tests operation of equipment under simulated ac source power failure.

2.2.1.5 Relays and Switches

Provide an under-voltage relay of the self-clearing type which automatically connects the lampload to the battery supply upon failure of the alternating current supply. Mount an on-off toggle switch inside the unit enclosure to disconnect the battery from the lampload when the unit is taken out of service for maintenance purposes. The relay energizes when the ac supply falls to 80 percent of normal voltage.

2.2.2 Self-Testing Module

Provide self-testing module for exit signs and emergency lighting equipment which performs the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. Conduct the battery capacity test using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Provide module with low voltage battery disconnect (LVD) and brown-out protection circuit.

PART 3 EXECUTION

3.1 INSTALLATION

Permanently fix in place the emergency lighting unit and install wiring
for each unit in accordance with NFPA 70. Use the same panel bus or branch circuit as that serving the normal lighting in the area for the branch circuit feeding the unit equipment, and connect ahead of area switches. Keep remotely connected emergency lighting circuit wiring independent of all other wiring and equipment and do not enter the same conduit, cable, box, or cabinet with other wiring unless the fixture is supplied from two sources.

Mount emergency lighting units and remote lamps at a minimum of 7 feet above the finished floor.

3.2 FIELD TESTING

Demonstrate emergency lighting units to operate satisfactorily in the presence of the Government Representative.

Perform and submit System Operational Tests in accordance with referenced standards in this section.

3.3 WARRANTY

Submit three (3) copies of warranty, signed by an authorized representative, designating the Government as warrantee, to the Government Representative, five (5) days prior to project closeout.

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EXIT SIGNS

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PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


UNDERWRITERS LABORATORIES (UL)

UL 924  (2006; Reprint Feb 2011) Standard for Emergency Lighting and Power Equipment

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Material, Equipment, and Fixture Lists shall be submitted for the following showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted for the following in accordance with paragraph entitled, "General Requirements," of this section.

Exit Lighting Units

SD-02 Shop Drawings

Installation drawings shall be submitted for Exit Lighting Units in accordance with the paragraph entitled, "Installation," of this section.
Outline drawings shall be submitted for Exit Lighting Units indicating overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Exit Lighting Units

SD-06 Test Reports

Test reports shall be submitted showing results of Operational Tests of exit lighting systems.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Emergency exit lighting fixtures shall conform to UL 924, NFPA 101, and as specified.

Exit lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Ceiling-mounted fixtures shall be designed to be supported independent of the ceiling. Fixtures shall be equipped with lamps.

2.2 CONTEMPORARY FIXTURES

Contemporary exit lighting fixture shall have a fixture body with edge-lighted plastic exit-sign panels, face trims, lamps, lampholders, and mounting brackets for top, back, and end mounting to walls and ceilings in accordance with NFPA 101, as indicated.

Fixtures shall be single face with thin wedge-shaped vertical cross sections. Top edge of double-face fixtures shall be not more than 2-3/4 inches thick. Top edge of single-face fixtures shall be not more than 2 inches thick. Bottom edge of double-face fixtures shall be not more than 1-3/4 inches thick. Bottom edge of single-face fixtures shall be not more than 1-1/4 inches thick.

Plastic sign panels shall be acrylic with red translucent letters and directional arrows, as required. Letters shall be 6-inches high with stroke not less than 3/4-inch wide.

Wireway cover and plastic sign backup plate shall be anodized sheet aluminum with a matte finish. Face trims shall be formed from sheet aluminum and shall have a brushed-satin finish. Fixture bodies formed from sheet steel shall be not less than 20 gage and painted.

Mounting plates and brackets formed from sheet aluminum or plate shall have a brushed-satin finish. Mounting plates shall be not less than 4-1/2 inches square and designed to secure the fixture to a 4 inch square outlet box.

2.3 EMERGENCY POWER LOSS EXIT LIGHTING UNITS

Each self-contained unit shall have an automatic power failure device,
test switch, pilot light, and fully automatic high/low solid-state trickle charger in a self-contained power pack. Battery shall be the sealed type and shall be maintenance-free for a period of not less than 10-years under normal operating conditions. Normal operation shall be with 120-volts.

2.4 LIGHT EMITTING DIODES (LEDs) EXIT LIGHTING FIXTURES

Exit lighting fixtures shall include sheetmetal enclosures with frames, battery charger, batteries, red light emitting diodes (LEDs) and mounting brackets. Fixtures shall be single faced. Mounting plates shall be suitable for securing the fixture to a 4 inch outlet box. Fixture features shall include continuous charging, automatic switching to standby batteries upon loss of power, overload protection, short circuit protection, test switch, low voltage disconnect, switch controlled left and right LED directional arrows, and shall be field connectable to operate from 115 volts. Minimum operating time of the battery system shall be three (3) hours for double faced fixtures and seven (7) hours for single faced fixtures. Brightness shall not be less than ten (10) candlepower. All components shall have a five year warranty.

PART 3 EXECUTION

3.1 INSTALLATION

Fixtures shall be connected to the main panel bus through overcurrent protection. Emergency lighting panel shall be used where available.

3.2 FIELD TESTING

Exit lighting shall be demonstrated to operate satisfactorily in the presence of the Government Representative.

Operational Tests shall be performed in accordance with referenced standards in this section.

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SECTION 26 56 00

EXTERIOR LIGHTING

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SECTION 26 56 00
EXTERIOR LIGHTING
07/06

PART 1  GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)


ASTM INTERNATIONAL (ASTM)


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.41  (2006) For Electric Lamps--Guidelines for Low-Pressure Sodium Lamps

ANSI ANSLG C78.42  (2009) For Electric Lamps: High-Pressure Sodium Lamps


1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
  Luminaire drawings; G
  Poles; G

SD-03 Product Data
  Local/Regional Materials
    Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

  Energy Efficiency
    Luminaires; G
    Lamps; G
    Ballasts; G
    Lighting contactor; G
    Photocell switch; G
    Aluminum poles; G
    Brackets

SD-06 Test Reports
  Operating test
    Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data
  Operational Service
    Submit documentation that includes contact information, summary
of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and candlepower distribution data shall accompany shop drawings.

1.5.1.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS-5, pole deflection, pole class, and other applicable information.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Government Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.
1.6  DELIVERY, STORAGE, AND HANDLING

1.6.1  Aluminum Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.7  SUSTAINABLE DESIGN REQUIREMENTS

1.7.1  Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 50 mile radius from the project site, if available from a minimum of three sources.

1.7.2  Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.8  WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.9  POWER SOURCE

Use a photovoltaic power source.

1.10  OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to the Government Representative. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2  PRODUCTS

2.1  PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 26 51 00 INTERIOR LIGHTING.

2.2  LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular
manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 High-Pressure Sodium (HPS) Lamps

ANSI ANSLG C78.42. Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum) for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps. Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0 percent
   1. 150-399 watts: minimum 58 LER for closed fixture; minimum 68 for open fixture
   2. 400-999 watts: minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1 percent - 10 percent
   1. 150-399 watts: minimum 64 LER for closed fixture; minimum 63 for open fixture
   2. 400-999 watts: minimum 82 LER for closed fixture; minimum 89 for open fixture
   3. 1000 plus watts: minimum 109 LER for open fixture

c. Upward efficiency of 11 percent to 20 percent
   1. 150-399 watts: minimum 78 LER for open fixture
   2. 400-999 watts: minimum 94 for open fixture

d. Upward efficiency greater than 20 percent
   150-399 watts: minimum 75 LER for closed fixture; minimum 77 for open fixture

2.2.1.2 Low-Pressure Sodium (LPS) Lamps

ANSI ANSLG C78.41.

2.2.1.3 Metal-Halide Lamps

Provide luminaires with tempered glass lens.

a. Double-ended, 70 watt, conforming to ANSI C78.1381

b. Single-ended, wattage as indicated, conforming to ANSI/ANSLG C78.43

Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0 percent
1. 150-399 watts: minimum 41 LER for closed fixture
2. 400-999 watts: minimum 53 LER for closed fixture; minimum 59 for open fixture
3. 1000 plus watts: minimum 77 LER for closed fixture

b. Upward efficiency of 1 percent - 10 percent
1. 150-399 watts: minimum 56 LER for closed fixture
2. 400-999 watts: minimum 62 LER for closed fixture; minimum 64 for open fixture
3. 1000 plus watts: minimum 88 LER for open fixture

c. Upward efficiency greater than 20 percent
1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open fixture
2. 400-999 watts: minimum 65 LER for closed fixture

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and ANSI C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90 percent). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 LIGHTING CONTACTOR

NEMA ICS 2, mechanically held contactor. Contacts shall be rated 600 volts, 30 amperes, and 3 poles. Coils shall be rated 120 volts. Rate contactor as indicated. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor and shall require no arcing contacts. Provide contactor with hand-off-automatic selector switch.

2.4 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 volts ac, 60 Hz with single pole double-throw (spdt) contacts for mechanically held contactors rated 1000 watts designed to fail to the ON position. Switch shall turn on at or below 3 footcandles and off at 4 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch:

aq. In a U.V. stabilized polycarbonate housing with swivel arm and
adjustable window slide, rated 1800 VA, minimum.

2.5 POLES

Provide poles designed for wind loading of 125 miles per hour determined in accordance with AASHTO LTS-5 while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole. Scratched, stained, chipped, or dented poles shall not be installed.

2.5.1 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS-5 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B108 and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B108. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel. Aluminum poles and brackets for walkway lighting shall have a dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

2.6 BRACKETS AND SUPPORTS

ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4 inch galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.7 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A153. Concrete shall be as specified in Section 03 30 04.00 12 CONCRETE FOR MINOR STRUCTURES.
2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Fiberglass Poles

Install according to pole manufacturer's instructions.

3.1.2 Aluminum Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure...
between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

3.1.3 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --
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1.2  REFERENCES
1.3  ADMINISTRATIVE REQUIREMENTS
   1.3.1  Pre-Installation Meeting
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   2.1.2  Design Requirements
      2.1.2.1  Sizes Of Motors
      2.1.2.2  Efficiency
   2.1.3  Electrically Driven Equipment
2.2  VOLTAGE RATINGS
2.3  TEMPERATURE RATING AND INSULATION
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3.2  ALIGNMENT
3.3  ELECTRICAL TESTS
3.4  VIBRATION TESTS
   3.4.1  Vibration Analyzer
   3.4.2  Vibration Data
3.5  OPERATION AND MAINTENANCE DATA
3.6  WARRANTY

-- End of Section Table of Contents --
### SECTION 26 60 13.00 40

**LOW-VOLTAGE MOTORS**

#### PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Designation</th>
<th>Year</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)</td>
<td>ABMA 11</td>
<td>(1990; R 2008)</td>
<td>Load Ratings and Fatigue Life for Roller Bearings</td>
</tr>
<tr>
<td></td>
<td>ABMA 9</td>
<td>(1990; R 2008)</td>
<td>Load Ratings and Fatigue Life for Ball Bearings</td>
</tr>
<tr>
<td>NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)</td>
<td>NEMA MG 1</td>
<td>(2011; Errata 2012)</td>
<td>Motors and Generators</td>
</tr>
</tbody>
</table>
1.3 ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3.1 Pre-Installation Meeting

The Government Representative will schedule a pre-installation meeting within 30 days of Contract Award. Provide the following for review and approval:

a. Submit informational drawings for Low-Voltage Motors indicating the overall physical features, dimensions, ratings, service requirements, and weights of equipment.

b. Submit equipment and performance data for Low-Voltage Motors consisting of:

   (1) Use life
   (2) System functional flows
   (3) Safety features
   (4) Mechanical automated details
   (5) Data curves indicating tested and certified equipment response and performance characteristics
   (6) Sample warranty with submittal for review and approval by the Government Representative

c. For Electric Motors rated over 20 hp and those specified to meet a special vibration class in accordance with NEMA MG indicate number of:

   (3) Rotational speed
   (4) Cooling fan blades

d. Submit manufacturer's instructions for Low-Voltage Motors including special provisions required to install equipment components and system packages. Include all special notices regarding detail impedances, hazards and safety precautions.

e. Submit certificates for the following tests showing conformance with the referenced standards contained in this section. Certified copies of previous test reports on identical Low-Voltage Motors may be submitted in lieu of factory test reports.

   (1) Factory test results
   (2) Efficiency
   (3) Power-Factor
   (4) Service factor
   (5) Temperature rating
(6) Noise
(7) Full-Load
(8) Locked-Rotor
(9) Insulation resistance
(10) Winding resistance
(11) High-Potential tests

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
   Sample Warranty
   Equipment and Performance Data
   Manufacturer's Instructions

SD-02 Shop Drawings
   Informational Drawings

SD-03 Product Data
   Motor Enclosures; G
   Rotational Speed; G
   Cooling Fan Blades; G

SD-07 Certificates
   Factory Test Results
   Efficiency
   Power-Factor
   Service Factor
   Temperature Rating
   Noise
   Full-Load
   Locked-Rotor
   Insulation Resistance
1.5 DELIVERY, STORAGE, AND HANDLING

Ensure all motors and related equipment are packaged and protected to prevent any damage during shipping, after acceptance of delivery, storage, and handling at the project site. Include manufacturer's instructions for proper handling and uncrating with the shipment of the Low-Voltage Motor(s).

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide Low-Voltage Motors of a sufficient size for the duty to be performed not exceeding the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.1.1 Motor Types

Provide Low-Voltage Motors of the following types:

a. 1/3 HP and smaller, single phase - capacitor start

b. 1/2 HP and larger, three-phase - induction squirrel-cage type, NEMA Design B, having normal starting torque and low starting current

2.1.2 Design Requirements

Provide Low-Voltage Motors (LVM) designed for across-the-line starting with torque characteristics to carry the specified rated starting load. Ensure LVM have factory-sealed ball bearings with an L-10 rated life of not less than 50,000 hours in accordance with ABMA 9 or ABMA 11.

Ensure design, fabrication, testing, allowable balance limits and performance of polyphase induction motors are in accordance with NEMA MG 1 and ISO 1940-1 and meets or exceeds the requirements as specified herein.

Provide the following motor design data prior to final turnover:

a. Number of motor rotor bars

b. Stator slots
c. Rotational speed  
d. Number of cooling fan blades  
e. RPM of motor  
f. Bearing manufacturer  
g. Bearing type  
h. Bearing style  
i. Number of balls/elements  
j. Number of commutator bars  
k. Commutator brushes

2.1.2.1 Sizes Of Motors

Provide motors of a sufficient size for the duty to be performed, and not exceeding the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.1.2.2 Efficiency

Ensure motors have efficiencies in accordance with the recommended levels specified in DOE CI-1.

Ensure efficiency labeling is in accordance with NEMA MG 1.

2.1.3 Electrically Driven Equipment

When electrically driven equipment differs from that indicated, ensure adjustments have been made to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, at no additional cost to the Government. Provide control and protective devices in accordance with Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

2.2 VOLTAGE RATINGS

Provide motors with the following minimum voltage ratings:

<table>
<thead>
<tr>
<th>MOTOR SIZE</th>
<th>HORSEPOWER</th>
<th>SERVICE</th>
<th>VOLTAGE RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractional horsepower, single-phase</td>
<td>1/3 and smaller</td>
<td>120/208-volt, 3-phase, 4-wire</td>
<td>115-volt, 60-hertz</td>
</tr>
<tr>
<td>Fractional and integral horsepower, 3-phase</td>
<td>1/2 and larger</td>
<td>120/208-volt, 3-phase, 4-wire</td>
<td>200-volt, 3-phase 60-hertz</td>
</tr>
</tbody>
</table>
2.3 TEMPERATURE RATING AND INSULATION

Provide motors designed for continuous operation at the rated full load in an ambient temperature of 104 degrees F, with an insulation level of at least Class F.

2.4 MOTOR HOUSINGS

Provide a smooth surface motor housing in the vertical, horizontal, and axial directions at each bearing housing for attaching a magnet mounted accelerometer in order to monitor the motor vibration. Ensure the smooth surface is on the bearing housing, with the axial surface as close to the motor centerline as possible. Provide a motor housing with a surface finish of 63 micro-inch minimum, corrosion resistant, with a minimum diameter finished surface of 2 inch. As an option sound disks with a minimum thickness of 3/8 inch can be used to meet the smooth surface requirement.

Ensure surface is level within 1 degree or .001 inch.

Identify the smooth surface using a printed label or embossed plate stating "Vibration data collection point - Do Not Paint".

2.5 MOTOR ENCLOSURES

2.5.1 Indoor Type Enclosures

For motors installed in indoor, nonhazardous locations where it is necessary to protect the motor from dirt, moisture, chemical fumes, or other harmful ingredients in the surrounding atmosphere, provide either of the following type of enclosure:

a. Totally enclosed fan-cooled enclosures for exterior cooling by means of a fan or fans integral with the machine but external to the enclosing parts, with a hinged access cover at each vibration collection point, large enough to enable the placement of a magnet/accelerometer data collection instrument.

2.5.2 Outdoor Type Enclosures

For motors installed in outdoor, nonhazardous locations, provide waterproof enclosures.

Provide all motors with weatherproof/waterproof enclosures with permanent accelerometers installed in the horizontal, vertical, and axial directions. Ensure the enclosure has a penetration installed to enable the accelerometer cables to be routed to outside the enclosure. Include a NEMA 4R rated data collection box mounted to the outside of the motor enclosure in a location that is easily accessible.
2.6 SERVICE FACTOR

Ensure service factor of general purpose and other open ac motors is in accordance with NEMA MG 1.

Provide totally enclosed ac motors with a service factor of 1.15.

2.7 FACTORY TESTS

Factory test all motors in accordance with the requirements of NEMA MG 1. Ensure polyphase induction motors are factory-tested in accordance with IEEE 112, Method B, consisting of measurements of voltage, frequency, speed, and current under no-load conditions; voltage, frequency, and current under locked-rotor conditions; and efficiency, noise, power factor, and thermal protection. Verify routine tests on wound-rotor induction motors include the measurement of wound-rotor open-circuit voltage across the slip rings under locked-rotor conditions. Provide written documentation of electrical tests including winding resistance, insulation resistance, and high-potential tests. Submit certified copies of factory test results for approval prior to shipment from the factory. Previous test reports on identical motors are not acceptable for these tests.

PART 3 EXECUTION

3.1 INSTALLATION

Install, align, and connect motors in accordance with the equipment manufacturer's instructions.

Mount motors with bolts. Ensure motor feet are coplanar within 0.001 inch, and base mounting points are accessible and adjustable to enable machine alignment. For motors over 20 hp, provide alignment jack bolts installed to enable alignment.

Recheck alignment of motors and adjust as required after the motor has been in operation for not less than 48 hours.

3.2 ALIGNMENT

Before attempting alignment, demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for motor and load at normal running temperatures. Ensure values are compensated for thermal growth. Correct limited movement of the motor or load (commonly known as bolt-bound) to ensure alignment capability. Do not undercut hold down bolts in order to perform adjustment.

Provide commercially die-cut shims, without seams or folds, made of corrosion resistant stainless steel. Use no more than four shims at any single point.

Align motor and load to the following minimum specifications:
### ELECTRICAL TESTS

Perform continuity test on all phases.

Perform insulation resistance and polarization index test on each phase of motor. Conduct insulation tests on 480-volt and 600-volt motors using a 1000-volt insulation test set. For insulation tests on motors rated less than 480-volts, use a 500-volt insulation test set.

Include in test data the location and identification of motors and megohm readings versus time. Record test data at 15, 30, 45 seconds, and in 1 minute increments thereafter up to 10 minutes. Ensure Megohm readings are not less than 25 megohms for each phase; and each phase reading is within 10 percent of the other two.

Perform inspections and test procedures on all motors in accordance with NETA ATS and NETA MAINT 7.15.1 for rotating machinery, AC motors.

Calculate the polarization index of each phase by dividing the 10 minute reading by the 1 minute reading. Verify that the polarization index is less than 1.25. Reject any lower values and return the motor to the factory.

### VIBRATION TESTS

#### Vibration Analyzer

To measure vibration levels, use a Fast Fourier Transformer (FFT) analyzer having the following characteristics:

- A dynamic range greater than 70 dB; a minimum of 400 line resolution
- A frequency response range of 5 Hz-10 KHz (300-600000 cpm)
- The capacity to perform ensemble averaging
- The capability to use a Hanning window
- Auto-ranging frequency amplitude
- A minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB

Use an accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) with the FFT analyzer.
to collect data. Ensure the mass of the accelerometer and its mounting have minimal influence on the frequency response of the system over the selected measurement range.

3.4.2 Vibration Data

Collect vibration data in the axial, vertical, and horizontal direction for each motor bearing.

Obtain two narrowband spectra for each data collection point in the following manner:

a. For all machines regardless of operating speed, obtain a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution.

b. Acquire an additional spectrum of 5 to 2500 or 5 to 5000 Hz for machines operating at or below 1800 RPM or greater than 1800 RPM, respectively.

Ensure vibration limits conform to the following:

<table>
<thead>
<tr>
<th>Frequency Range(CPM)</th>
<th>Vibration limit(inch/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3xRPM to 0.8xRPM</td>
<td>0.04</td>
</tr>
<tr>
<td>0.8xRPM to 1.2xRPM</td>
<td>0.75</td>
</tr>
<tr>
<td>1.2xRPM to 3.5xRPM</td>
<td>0.04</td>
</tr>
<tr>
<td>3.5xRPM to 120,000cpm</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Provide final test reports to the Government Representative. Include with reports a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

3.5 OPERATION AND MAINTENANCE DATA

No later than 30 days prior to final acceptance, submit manufacturer's operating and maintenance manual to the Government Representative.

3.6 WARRANTY

No later than 30 days prior to final acceptance, submit manufacturer's warranty to the Government Representative.

-- End of Section --
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SEPARATOR GEOTEXTILE

05/09

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3.2 SEAMS AND LAPS
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PART 1 GENERAL

1.1 SCOPE

The work provided for herein consists of furnishing all plant, labor, material, equipment; performing all operations required for furnishing, hauling, placing the separator geotextile; and maintaining the geotextiles until placement of the riprap or crushed stone is completed and accepted.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D883 (2011) Terminology Relating to Plastics

ASTM D4491 (1999a; R 2009) Water Permeability of Geotextiles by Permittivity


ASTM D4884 (2012) Strength of Sewn or Thermally Bonded Seams of Geotextiles

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Plan

The Contractor shall submit a work plan to the Government Representative. The plan shall include the following information:
a. The dimensions of the geotextile panels, whether the geotextile will be seamed, lapped, or both. Distance between laps, if applicable.

b. A detailed description of how the geotextile will be placed and stretched.

SD-03 Product Data
Geotextile; $G$

SD-04 Samples
Geotextile

A 5-foot by 5-foot sample of each geotextile that the Contractor plans to use shall accompany the certificate. If seams are to be used, then an additional 5-foot by 5-foot sample of each geotextile containing a sample seam in the center of the geotextile sample shall be submitted with the certificate. Geotextiles shall not be delivered to the project site until the Government Representative approves their certificates.

SD-07 Certificates
Geotextile

Contractor shall submit the geotextile manufacturer's certification of compliance. All brands of geotextile and all seams that are used in construction shall be accepted on the following basis. At least 30 days prior to installation, the Contractor shall furnish to the Government Representative, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The certificate shall contain the signer's title, name and address of the Contractor, contract number, and project name and location. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical, and manufacturing requirements stated in this specification and that the seams used meet the seam requirements.

1.5 QUALITY CONTROL

1.5.1 General

The Contractor shall establish and maintain quality control for the geotextile and placement to assure compliance with contract requirements, and maintain records of his quality control for all construction operations including but not limited to the following:

(1) Installation Equipment. Type, size and suitability for construction of the prescribed work.

(2) Geotextile Submittals. Geotextile samples, manufacturer's certification of compliance, and work plan.

(3) Construction. Lay-out, geotextile inspection, and stone placement above the geotextile.
1.5.2 Reporting

The original and two copies of these records, as well as the records of corrective action taken, shall be furnished the Government daily. Format of report shall be as prescribed in the Section 01 45 04.00 12 CONTRACTOR QUALITY CONTROL.

1.6 SHIPMENT AND STORAGE

Geotextile shall be shipped and maintained in a heavy-duty protective cover until it is placed. During all periods of shipment and storage, the geotextile shall be protected from direct sunlight, ultra-violet rays, temperatures greater than 140 degrees Fahrenheit, mud, dirt, and other contaminants. Geotextiles delivered to the project site shall be clearly marked to show the brand name, type of geotextile, tensile strength, location and date of manufacture, and its length (machine direction) and width.

PART 2 PRODUCTS

2.1 GEOTEXTILE

The geotextile shall be a woven pervious sheet made with plastic yarn as defined by ASTM D883. The geotextiles shall meet the requirements listed in Table 1. Geotextile fibers shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amide, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic, if necessary, to make the filaments resistant to deterioration due to ultra-violet exposure. The edges of the geotextile shall be selvedged.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>ACCEPTABLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Breaking Load</td>
<td>ASTM D4632</td>
<td>200 pounds minimum in any principal direction</td>
</tr>
<tr>
<td>Seam Strength (**)</td>
<td>ASTM D4884</td>
<td>100 pounds per inch minimum</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>ASTM D4632</td>
<td>15 percent minimum in any principle direction</td>
</tr>
<tr>
<td>Apparent Opening Size</td>
<td>ASTM D4751</td>
<td>No finer than the U.S. Standard Sieve No. 70 and no coarser than the U.S. Standard Sieve No. 30</td>
</tr>
<tr>
<td>Permittivity</td>
<td>ASTM D4491</td>
<td>0.35 per second minimum</td>
</tr>
</tbody>
</table>

(*) Value represents minimum average roll value of new geotextile received from the manufacturer or distributor.

(**) All of the samples shall yield test values that are greater than the minimum value that is specified.
TABLE 1
REQUIREMENTS* FOR SEPARATOR GEOTEXTILE

PART 3  EXECUTION

3.1  GEOTEXTILE INSTALLATION

The geotextile shall be placed in the manner and at the locations shown on the drawings. The Contractor shall prepare the surface to receive the geotextile to insure that the surface is relatively smooth and free of obstructions, depressions, debris, soft or low density pockets of material, or stone which could damage the geotextile during placement. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The geotextile shall be protected at all times during construction to insure that the geotextile's original chemical and physical properties are not changed. The work shall be scheduled so that all of the geotextile that is placed is covered with a layer of the specified material by the end of each workday. Failure to comply shall require replacement of geotextile. All wrinkles and sags shall be stretched out immediately before stone is placed on the geotextile. The geotextile shall be protected from damage during placement of riprap. This shall be accomplished by limiting the height of drop to less than 1 foot, or the water surface, whichever is greater. In the event that this damages the geotextile, the riprap shall be placed directly on the geotextile with zero height of drop. Before placement of riprap the Contractor shall demonstrate that the placement technique will not damage the geotextile. The Contractor at no additional cost to the Government shall replace any geotextile that is rejected or damaged.

3.2  SEAMS AND LAPS

Seams or laps may be utilized to produce panels of geotextile large enough to cover the area shown on the drawings. Seams or laps shall not run parallel with the direction of the centerline.

3.2.1  Seams

All seams shall be sewn using thread meeting the requirements for plastic yarn specified in paragraph "GEOTEXTILE". The sheets of geotextile shall be sewn at the factory or other approved location. Seam strengths shall meet the requirements of Table 1.

3.2.2  Laps

Geotextile panels placed along the centerline shall be overlapped a minimum of 2 feet with the upstream panel on top of the downstream panel.

-- End of Section --
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1.2   REFERENCES
1.3   SUBMITTALS
1.4   QUALITY ASSURANCE
1.5   DELIVERY, STORAGE, AND HANDLING
  1.5.1   Labeling
  1.5.2   Handling
  1.5.3   Storage

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2.1   GEOGRID REINFORCEMENT
  2.1.1   Geogrid Reinforcement Properties
2.2   SPLICES

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3.1   INSTALLATION
  3.1.1   Subgrade Preparation
  3.1.2   Anchor Trench
  3.1.3   Placement
  3.1.4   Overlaps and Fasteners
  3.1.5   Splices
  3.1.6   Penetrations
3.2   COVER SOIL PLACEMENT
3.3   OVERSIGHT
3.4   CONFORMANCE TESTING

-- End of Section Table of Contents --
PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM D4873 (2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples


GEOSYNTHETIC INSTITUTE (GSI)

GSI GRI GG4a (1991) Determination of the Long-Term Design Strength of Stiff Geogrids


GSI GRI GG6 (1996) Grip Types for Use in Wide Width Testing of Geotextiles and Geogrids

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

   SD-02 Shop Drawings
   Installation; G
   SD-03 Product Data
1.4 QUALITY ASSURANCE

Submit a summary of the manufacturer's qualifications and manufacturer's quality control (QC) manual a minimum of seven (7) days prior to delivery of geogrid to the site. The reinforcement manufacturer shall provide a qualified and experienced representative to be available on an as-needed basis during construction. The representative shall visit the site for consultation at least once during construction and as requested by the Government Representative.

1.5 DELIVERY, STORAGE, AND HANDLING

Check products upon delivery to ensure that the proper material has been received and is dry and undamaged. Protect the materials from damage and exposure following the guidelines presented in ASTM D4873.

1.5.1 Labeling

Label each roll with the manufacturer's name, product identification, roll dimensions, lot number, and date manufactured.

1.5.2 Handling

Handle and unload geogrid rolls by hand, or with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Geosynthetic rolls shall not be dragged, lifted by one end, lifted by cables or chains, or dropped to the ground.

1.5.3 Storage

Protect geogrid from deleterious materials, chemicals, sparks and flames, temperatures in excess of 160 degrees F, and any other environmental condition that may degrade the physical properties. If stored outdoors, the rolls shall be elevated from the ground surface. Protect geogrids, except for extruded grids, with an opaque waterproof cover.

PART 2 PRODUCTS

2.1 GEOGRID REINFORCEMENT

Submit one (1) properly identified 24 by 24 inches minimum size geogrid
sample with the fasteners proposed for use. Provide a geogrid that is a geosynthetic manufactured for reinforcement applications and a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil, aggregate, or other fill materials.

a. Submit manufacturer's certified raw and roll material test reports including ultimate strength performed in accordance with ASTM D6637 or ASTM D4595 (modified). Test results not meeting the requirements in Table 1 or in the approved Manufacturer's Quality Control Manual will result in rejection of applicable rolls. Provide certified test reports a minimum of seven (7) days prior to delivery of geogrid to the site.

b. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. The geogrid shall be manufactured with 100 percent virgin resin consisting of polyethylene, polypropylene, polyester, or other approved material and with a maximum of 5 percent in-plant regrind material. Polyester resin shall have a minimum molecular weight of 25,000 and a carboxyl end group number less than 30. Polyethylene and polypropylene shall be stabilized with long term antioxidants.

c. Submit Certificates of Compliance for the materials provided and results of conformance testing. Submit an affidavit certifying raw and roll material test results submitted are accurate and that the reinforcement meets the requirements of the project specifications. The affidavit shall be signed by an official authorized to certify on behalf of the manufacturer. The documents shall include a statement confirming that all purchased resin used to produce reinforcement is virgin resin. Provide affidavit a minimum of seven (7) days prior to delivery of geogrid to the site.

2.1.1 Geogrid Reinforcement Properties

The reinforcement shown on the contract drawings shall meet the property requirements listed in Table 1. Reinforcement strength requirements represent minimum average roll values in the machine direction.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Integrity</td>
<td></td>
</tr>
<tr>
<td>Junction efficiency(3), %</td>
<td>93</td>
</tr>
<tr>
<td>Aperture stability(4), kg·cm/deg @ 5.0kg-cm(2)</td>
<td>3.0</td>
</tr>
<tr>
<td>Radial stiffness at low strain(5), kN/m@0.5% strain</td>
<td>225</td>
</tr>
<tr>
<td>(lb/ft @ 0.5% strain)</td>
<td>(15,430)</td>
</tr>
<tr>
<td>PROPERTY</td>
<td>REQUIREMENT</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Durability</td>
<td></td>
</tr>
<tr>
<td>Resistance to chemical degradation(6)</td>
<td>100%</td>
</tr>
<tr>
<td>Resistance to ultra-violet light and weathering(7)</td>
<td>100%</td>
</tr>
</tbody>
</table>

Notes:
(1) Load transfer capability determined in accordance with GRI-GG2-87 and GRI-GG1-87 and expressed as a percentage of ultimate tensile strength.
(2) In-plane torsional rigidity measured by applying a moment to the central junction of a 225 mm x 225 mm specimen restrained at its perimeter in accordance with U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity, (Kinney, T.C. Aperture stability Modulus ref 3, 3.1.2000).
(3) Radial stiffness is determined from tensile stiffness measured in any in-plane axis from testing in accordance with ASTM D6637-01.
(4) Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.
(5) Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance with ASTM D4355-05.

2.2 SPLICES

Splices shall consist of a standard method or device recommended by the manufacturer of the geogrid. Splices will not be allowed unless identified on the approved layout drawings. Splices shall be at least 75 percent efficient. Demonstrate the splice efficiency through tests performed in accordance with GSI GRI GG4a or GSI GRI GG4b. Splicing may consist of overlaps, fusion wedge welding, sewing, or bodkin connections. Splicing methods that are dependent on installer experience and skill level, such as hot air and torch-applied open flame, are not acceptable. Construct overlap splices by placing a minimum of 2 inches of soil between the layers of geogrid.

PART 3 EXECUTION

3.1 INSTALLATION

Submit Geogrid layout plan along with anchorage and joint details, sequencing and construction procedures, a minimum of 7 days prior to geogrid placement.

3.1.1 Subgrade Preparation

Immediately prior to placement of the geogrid, the surface on which the geogrid will be placed shall be free of rock and other material that could damage the geogrid or the underlying geosynthetics.

3.1.2 Anchor Trench

Place the anchor trench a minimum of 24 inches back from the edge of the slope to be covered. The anchor trench shall be a minimum of 24 inches deep and 24 inches wide. Remove ponded water from the anchor trench while the trench is open. Trench corners shall be rounded to avoid sharp bends.
in the geogrid. Remove loose soil, rocks larger than 2 inches in
diameter, and any other material which could reduce the effectiveness of
the geogrid from the surfaces of the trench. Extend the geogrid down the
front wall and across the bottom of the anchor trench. Perform
backfilling and compaction of the anchor trench in accordance with Section
31 24 00.00 12 EMBANKMENT.

3.1.3 Placement

Install the geogrid in accordance with the Manufacturer's
recommendations. Unroll the geogrid in the direction of reinforcement.
After a layer of geogrid has been placed, use suitable means, that do not
damage the underlying geosynthetics, to hold the geogrid flat and in place
until cover soil can be placed. Geogrid damaged during placement and
covering shall be removed and replaced at no additional cost to the
Government.

3.1.4 Overlaps and Fasteners

Adjacent rolls of geogrid shall be positioned edge-to-edge and loosely
fastened to maintain alignment during fill placement. Adjacent rolls
shall not be overlapped. Use fastener type and spacing as recommended by
the manufacturer and approved by the Government Representative. Metallic
fasteners will not be allowed.

3.1.5 Splices

Submit test data showing splice efficiency. Provide certified test
results a minimum of seven (7) days prior to delivery of geogrid to the
site. Locate splices, if allowed, within the bottom one-third of the
slope. Limit splicing to only one splice per reinforcing strip and no two
consecutive reinforcing strips shall include a splice. Individual
reinforcing lengths less than 10 feet shall not be used. Splices in
gregid reinforcement shall be pulled and held taut during cover soil
placement.

3.1.6 Penetrations

For small penetrations through geogrids, only transverse members of the
gregid shall be cut. The load-carrying longitudinal (machine direction)
members shall be spread around the penetration. For larger penetrations,
additional geogrid shall be placed on each side of the penetration and
spliced to the adjacent geogrid to compensate for any longitudinal tensile
members that must be cut.

3.2 COVER SOIL PLACEMENT

Cover geogrid with soil within 5 calendar days of acceptance. Keep the
gregid smooth and taut during placement of cover materials. Cover soil
shall not be dropped onto the geogrid from a height greater than 3 feet.
The soil shall be pushed out over the geogrid in an upward tumbling
motion. Place soil from the bottom of the slope upward. The initial
loose soil lift thickness shall be 12 inches. Use equipment with ground
pressures less than 7 psi to place the first lift over the geogrid. A
minimum of 18 inches of soil shall be maintained between construction
equipment with ground pressures greater than 7 psi and the geogrid.
Equipment placing cover soil shall not stop abruptly, make sharp turns,
spin their wheels, or travel at speeds exceeding 5 mph. Additional cover
soil material and placement requirements are described in Section
3.3 OVERSIGHT

Keep a QA Representative present at all times during geogrid installation.

3.4 CONFORMANCE TESTING

Submit results of conformance testing. Conformance testing expenses are the responsibility of the Contractor. Perform testing using a commercial testing laboratory selected by the Contractor and approved by the Government Representative. The laboratory shall be accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) for the tests the laboratory will be required to perform. The Government Representative reserves the right to direct the location and select the material for samples. Conformance test results shall equal or exceed results reported on the Manufacturer's certified roll material test reports.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST DESIGNATION</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide Width Strip</td>
<td>ASTM D4595 (mod)</td>
<td>20,000 LF</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>or ASTM D6637</td>
<td></td>
</tr>
</tbody>
</table>

Modify ASTM D4595 for geogrids considering recommendations in GSI GRI GG6. Express the tensile strength on a unit length basis by substituting n*a for Ws, where:

- Ws = specimen width, (inches)
- n = number of ribs in the sample (must be a whole number)
- a = nominal rib spacing for the product tested, (inches)

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CLEARING AND GRUBBING

04/08

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1.3 QUALITY CONTROL

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations necessary for the clearing and grubbing of the areas specified herein or indicated on the drawings, for the removal and disposal of all cleared and grubbed materials, and for the filling of all holes caused by grubbing operations, as specified herein.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 QUALITY CONTROL

The Contractor shall establish and maintain quality control for clearing and grubbing operations to assure compliance with contract requirements, and maintain records of his/her quality control for all construction operations including but not limited to the following:

(1) Clearing. Station to station limits; transverse clearing limits from applicable centerline; percentages of area complete; type of material.

(2) Grubbing. Station to station limits; transverse grubbing limits from applicable centerline; percentage of area complete; type of material.

(3) Disposition of Cleared and Grubbed Materials. Method and location of disposition; damage to timber or improvements which are not to be cleared.

The original and two (2) copies of these records of inspections and tests, as well as the records of corrective action taken, shall be furnished to the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2   PRODUCTS (NOT USED)

PART 3   EXECUTION

3.1 GENERAL REQUIREMENTS

All clearing and grubbing work for conveyance channel shall be completed at least 1,000-feet in advance of conveyance channel construction. In locations where work on structures is performed, all clearing and grubbing shall be completed in advance of the structure and within the
limits as shown on the plans. If regrowth of vegetation or trees occurs after clearing and grubbing and before placement of fill, the Contractor will be required to clear and grub the area again prior to conveyance channel construction, and no payment will be made for this additional clearing and grubbing.

3.2 CLEARING

3.2.1 General

Clearing, unless otherwise specified, shall consist of the complete removal above the ground surface except as indicated below of all trees, stumps, down timber snags, brush, vegetation, old piling, loose stone, abandoned structures, fencing and similar debris. Growth standing in water in areas that are not drained in accordance with Section 31 24 00.00 12 EMBANKMENT, paragraph "Drainage" may be cut off so as not to protrude more than 12 inches above the existing water surfaces.

3.2.2 Merchantable Timber

Merchantable timber remaining within the areas to be cleared on or after the date of award of this contract may be disposed of as the Contractor sees fit, as long as such merchantable timber is either removed from the right-of-ways indicated on the drawings or is satisfactorily disposed of in accordance with the provisions of paragraph "DISPOSAL OF DEBRIS".

3.2.3 Government Surveys

The Contractor shall clear the baseline traverse, centerline traverse, and ranges at all P.C.'s, P.I.'s, P.T.'s, 100 foot centerline stations and tie-in stations to facilitate the taking of original cross-sections by the Government. This clearing shall consist of the removal to within 6 inches of the ground surface of all trees, brush and vegetation. This clearing shall be completed in 1,000 foot increments and in advance of conveyance channel construction by a minimum of 1,000 feet.

3.2.4 Trees

Certain trees, as designated by the Government Representative, shall be left standing. Trees shall be felled in such a manner as to avoid damage to trees to be left standing, to existing structures and installations and to those under construction, and with due regard for the safety of employees and others.

3.2.5 Vegetation

Vegetation to be removed shall consist of crops, grass, bushes, and weeds. Close-growing grass and other vegetation shall be removed from areas to receive embankment or road fill to provide a complete bare earth surface immediately prior to foundation preparation. Removal of vegetation from the side of existing levees shall be limited to 500 feet in advance of embankment placement. Acceptance of the vegetation removal operation shall precede the initiation of foundation preparation in the area from which vegetation has been removed. Removal of marsh grass will not be required.
3.2.6 Areas to be Cleared

3.2.6.1 General

The entire area as shown on the plans contiguous thereto, above ground structures, traverses, ditches, and channels within the right-of-way shall be cleared.

3.3 GRUBBING

3.3.1 General

Grubbing shall consist of the removal of all stumps, roots, buried logs, old piling, old paving, old foundations, pipes, drains, and other unsuitable matter as described in Section 31 24 00.00 12 EMBANKMENT, paragraph "MATERIALS" and as shown on plans.

3.3.2 Areas to be Grubbed

3.3.2.1 Embankments and Structures

Grubbing shall be performed within the limits of the embankment and all structures together with the 5 foot strips contiguous thereto. All roots and other projections over 1 1/2-inches in diameter shall be removed to a depth of 3 feet below the natural surface of the ground or surface of existing embankments and to a depth of 3 feet below the subgrade for the foundation of structures. The areas to be grubbed are those specific areas within the limits specified herein above from which trees, stumps, down timber, snags, old piling, abandoned structures, and other projections have been removed. In the event the areas specified in Section 31 24 00.00 12 EMBANKMENT, paragraph "Drainage" are not drained, and growth and projections standing in water are cut off as permitted in paragraph "General", grubbing within such areas will not be required.

3.3.2.2 Channels and Ditches

All stumps and exposed roots and other obstructions shall be removed from within the limits of all channels and ditches to be constructed.

3.3.3 Filling of Holes

All holes caused by grubbing operations and removal of pipes and drains, channels and ditches shall be backfilled with suitable material in 12 inch layers to the elevation of the adjacent ground surface, and each layer compacted to a density at least equal to that of the adjoining undisturbed material.

3.4 DISPOSAL OF DEBRIS

3.4.1 General

All debris resulting from clearing and grubbing operations at the construction site shall be removed from the site. The Contractor shall make a reasonable effort to channel merchantable material into the commercial market to make beneficial use of materials resulting from clearing and grubbing operations.
3.4.2 Removal From Site of Work

The Contractor shall remove all of the debris from the site of the work. Such disposal shall comply with all applicable Federal, State, and Local laws. The Contractor shall, at his/her option, either retain for his/her own use or dispose of by sale or otherwise, such materials of value. The Government is not responsible for the protection and safekeeping of any materials retained by the Contractor. Such materials shall be removed from the site of the work before the date of completion of the work. If debris from clearing operations is placed on adjacent property, the Contractor shall obtain, without cost to the Government, additional right-of-way, temporary easements or servitudes for such purposes. Such material shall be so placed as not to interfere with roads, drainage or other improvements and in such a manner as to eliminate the possibility of its entering into channels, ditches, or streams. The Contractor shall submit written evidence to the Government Representative that he/she has obtained from the property owner permission for disposal of material on the owner's property. The written evidence shall consist of an authenticated copy of the conveyance under which the Contractor acquired the property rights and access thereto, prepared and executed in accordance with the laws of the State of Louisiana. If temporary rights are obtained by the Contractor, then the period of time shall coincide with the requirements in the Section 00700 Standard General Conditions. However, delay resulting from acquisition of additional rights-of-way for alternate disposal areas will not qualify as excusable delays if suitable Government-furnished disposal areas are available.

Approved disposal sites in the vicinity are as follows:

- River Birch Landfill
  2000 Hwy. 90
  Avondale, LA 70094

- Jefferson Parish Landfill
  5800 Hwy. 90
  Avondale, LA 70094

- Industrial Pipe-Plaquemines Parish
  11266 Highway 23
  Belle Chasse, LA 70037

- Amid Landfill, Orleans Parish
  11005 Almonaster Ave.
  New Orleans, LA

3.4.3 Removal of Abandoned Drainage Structures

Drainage structures, including all pipes and drains, shall be removed from the work site in accordance with paragraph "Removal From Site of Work".
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EXCAVATION

9/2010

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  3.5.1 Excavation

-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations necessary for excavation in borrow areas and of existing levees, removal of material from embankment foundations and all other excavation incidental to the construction of embankments, conveyance channel, headworks, pump station, sedimentation basin and embankment cuts as specified herein and as shown on the drawings.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 QUALITY CONTROL

The Contractor shall establish and maintain quality control for excavation operations to assure compliance with contract requirements, and maintain records of its quality control for all construction operations including but not limited to the following:

(1) Borrow Areas. Location, station limits, actual and allowable depths, drainage, and substitute borrow areas. Before and after excavation, the Contractor shall perform, plot and submit compliance cross sections to the Government Representative at a maximum of 300 feet intervals within the borrow areas with the theoretical sections superimposed thereon.

(2) Disposition of Materials. Testing Program, Location of tested materials (station and lift), Applicable Compaction Curves.

(3) Ditches. Locations grade and cross-section.

(4) Traverses. Locations and dimensions.

(5) Retaining Dikes. Check elevations and wastewater.

(6) Quantity Surveys. Accuracy and timeliness.

The original and two (2) copies of these records of inspections and tests, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2   PRODUCTS

Not Used.
PART 3 EXECUTION

3.1 EXCAVATION IN BORROW AREAS

3.1.1 General

The Contractor shall provide the types of equipment as necessary to perform the required excavation according to the in situ conditions of the borrow area.

3.2 CONTRACTOR-FURNISHED BORROW AREAS

3.2.1 General

The Contractor, at its option, may use borrow areas other than those indicated provided that the Government Representative approves their locations and dimensions. The Contractor shall submit a written statement to the Government within fifteen (15) days after contract award on their intention to provide a Contractor-furnished borrow source. The statement shall include the proposed site name, a description of the location, and a vicinity map. The Contractor shall ensure that any Contractor-furnished borrow area submitted has all applicable environmental documentation acquired, current, and up-to-date, as described in paragraph "Submittal Package Requirements in Detail". All costs arising or growing out of the use of Contractor-furnished borrow areas shall be borne by the Contractor. The Contractor shall submit the information described in paragraph "Submittal Package Requirements in Detail" to the Government Representative for review and approval.

3.2.2 Time Extensions

No time extension to the contract completion date will be granted to the Contractor for delays incurred in obtaining Contractor-furnished borrow areas. The Contractor shall be solely responsible for any and all damages, claims for damages, and liability of any nature whatsoever arising from or growing out of the use of borrow areas other than those furnished by the Government.

3.2.3 Approval

Approval of the location and dimensions of the Contractor-furnished borrow area shall neither relieve the Contractor from its obligation to furnish satisfactory material to the project nor commit the Government to the acceptance of the responsibility for the character, quantity, or availability of material in Contractor-furnished borrow areas.

3.2.4 Submittal Package Requirements

The Contractor in a single, complete package in quadruplicate shall submit the following information. The Contractor shall allow a minimum of ninety (90) days, after the receipt of the package, for the Government's review, processing, and approval. Ten (10) days for Contractor furnished borrow utilizing a clay source.

(1) Zoning classification.

(2) Louisiana Department of Transportation and Development (LADOTD) permits or approvals.
(3) Maps as follows:

(a) Location and Direction map.

(b) Topographic map(s) with scale of 1:24,000.

(c) Layout map with dimensions and property boundary defined by latitude and longitude.

(d) Soil boring location map.

(4) Plotted cross section.

(5) Soil boring logs and report, and laboratory soil classification test results.

(6) Cultural resources investigation report. (Not required for Contractor furnished borrow utilizing a clay sources.

(7) Salinity and sodium content test results.

(8) Excavation plan.

(9) Environmental protection plan.

3.2.5 Submittal Package Requirements in Detail

3.2.5.1 Zone Classification

Written evidence that the property intended for use as a Contractor-furnished borrow area contains the proper zoning classification that will allow the Contractor to excavate the property and use it as a borrow area. This evidence shall consist of a letter from the local land zoning office stating the zoning classification of the proposed Contractor-furnished borrow area.

3.2.5.2 Maps

The following maps shall be provided:

(1) A map of the general area giving detailed instructions on how to get to the Contractor-furnished borrow area from the nearest major highway.

(2) A topographic map(s) (quadrangle) with a scale of 1:24,000 with the location of the borrow area superimposed. The map should be zoomed out enough to show the nearest city or town.

(3) A layout map of the borrow area showing the dimensions of the borrow area proposed excavation, locations of soil borings, and latitude/longitude points to reference property boundaries. The map shall show the location and dimensions of any haul road that exists or is to be constructed to help the Contractor in its hauling operation. The map shall also show the location and dimensions of any protection dikes which will help the Contractor drain and keep the borrow area dry.

(4) The most recent parish surface soils map with the location of the borrow area superimposed.
3.2.5.3 Plotted Cross Sections

Plotted cross sections of the Contractor-furnished borrow area in sufficient quantity (maximum of 300-foot intervals) to give a true representation of the topography of the Contractor-furnished borrow area. The proposed excavation lines shall be superimposed on these cross sections, so that an accurate computation of the available material can be made.

3.2.5.4 Soil Boring Logs and Report and Laboratory Soil Classification Test Results

Soil borings of the Contractor-furnished borrow area, witnessed by a Government representative, shall be made by the Contractor to a depth of at least 5 feet below the depth of planned excavation. The borings shall be furnished by the Contractor at a spacing that will adequately define the material in the pit but in no case spaced greater than 500 feet on centers. Borings along the proposed borrow area boundary shall be located no farther apart than one-half of the boring spacing in the pit or 250 feet, whichever is less. Soil samples from these borings shall be classified in accordance with the Unified Soil Classification system and shall include water content determinations based on the dry weight of the representative soil samples, taken at each 2.5 feet of depth of the boring and at each change in strata. These representative soil samples shall be submitted to an approved independent laboratory, properly labeled and sealed in an airtight container to preserve the natural water content for laboratory determination. The resulting classification and water content determination and borrow area boring logs shall be submitted to the Government Representative for determination of the suitability of the material for construction use. In addition to soil classification and water content sampling, representative soil samples, taken at each 2.5 feet of depth of the boring and at each change in strata, shall be submitted to an approved independent laboratory for salinity and sodium level tests as further specified in paragraph "Salinity and Sodium Content Tests". Soil boring locations shall be shown on the layout map required by paragraph "Maps"(3).

(1) Permeability

If examination of the submitted soil samples confirms that the material in the Contractor-furnished borrow area is as or less permeable than the material in the Government-furnished borrow area, the Contractor-furnished borrow material may be used provided the quality of the material is otherwise satisfactory. However, if the material in the Contractor-furnished borrow area is more permeable than material in the Government-furnished borrow area indicated, the Contractor-furnished borrow material may not be used.

3.2.5.5 Cultural Resources Investigation Report

A written report by a professional archeologist which meets the report requirements of the Louisiana Division of Archeology and explains the results of the field investigation made by him of the Contractor-furnished borrow area. The field investigation shall consist of a comprehensive inspection of the proposed borrow area, including access roads, and shall be adequate enough to determine if any cultural resources that are eligible for listing in the National Register will be impacted. The Government Representative and the cultural resources specialists will
evaluate this report to determine the adequacy of the cultural resources investigation to discharge the cultural resource responsibilities. The cultural resource specialist will consult with the Louisiana State Historic Preservation Officer (LSHPO) and all other required agencies. All costs of mitigating adverse effects to cultural resources, if required, shall be borne by the Contractor. It is the responsibility of the Contractor to ensure that its proposed excavation does not impact significant cultural resources.

3.2.5.6 Salinity and Sodium Content Tests

The Contractor-furnished borrow area material shall be tested for levels of salinity and/or sodium content which could impede the satisfactory establishment of grass. Specific tests to be performed shall include the routine soils test package (pH, extractable P, K, Ca, Mg, Na, S, Cu and Zinc) and total soluble salts. All costs associated with the testing of the Contractor-furnished borrow material shall be borne by the Contractor.

3.2.5.7 Excavation Plan

The Contractor shall provide the Government Representative a plan for clearing, stripping, and excavating materials from the proposed Contractor-furnished borrow area. In its plan, the Contractor shall show work areas, stockpile areas, etc, all within its leased or owned property boundaries. The Contractor shall not work or move material outside the boundaries of the approved limits of its borrow area. The Contractor shall indicate in writing and show on its layout plans details of the following:

1. A stockpile plan for cleared and stripped material and debris to include disposal areas.

2. The locations for disposal of wasted material discovered in the borrow area. Location of any haul roads constructed to help the Contractor in its hauling operations.

3. A plan for stockpiling embankment material before it is transported to the project site to include locations, stockpile heights, slopes, and limits.

4. The method and route for transporting the excavated material from the Contractor-furnished borrow area to the project site.

5. The proposed methods for draining and keeping dry during excavation the borrow area excavated under this contract, including any protection dikes constructed to alleviate drainage problems.

6. A complete list of excavation and transportation equipment planned for use in its operations.

7. The Contractor's proposed sequence of excavating the borrow area showing starting and ending work locations.

8. A list of the permits required and issuing office.

3.2.5.8 Environmental Protection Plan

A proposal for implementing Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION of this contract insofar as that section applies to borrow
areas.

3.2.6 Government Performed Environmental Assessment

The Government is required to perform an environmental assessment on all new proposed borrow areas without regard to the source. An environmental assessment requires a minimum of ninety (90) days for review, processing, and approval time by the Government. Before the Government will commence the environmental assessment of a proposed Contractor furnished borrow site, the Contractor must submit all of the above items as a single, complete package. The Government Representative reserves the right to disapprove the use of Contractor-furnished borrow areas located in woodlands or wetlands. The Government shall be reimbursed by the Contractor for actual costs incurred for assistance in completing or attempting to complete additional environmental coordination and documentation, which expenses will not exceed $250,000.

3.3 DISPOSITION OF MATERIALS

Remove from the site surplus or other soil materials not required or suitable for filling or backfilling, and brush, refuse, stumps, roots and timbers.

3.4 HAULING

All excavated material to be hauled to the site from the borrow source, or to be removed from the site, including debris, shall be hauled in watertight trucks with secured binders on tailgates to the place of destination. The route for trucks carrying material to and from the job site, and to and from the borrow area shall avoid residential streets, and shall be approved by the Government Representative. Trucks shall not spill or track mud on public roads. The Contractor shall take immediate action to clean up any material spilled on the roads without notification from the Government Representative. Failure by the Contractor to satisfactorily clean public roads used for the hauling operation shall result in the suspension of hauling operations until such roads are cleaned to the satisfaction of the Government Representative.

3.5 GRADE TOLERANCES

3.5.1 Excavation

All excavation shall be cut to the grades and cross sections shown on the drawings. For excavation in the borrow area(s), a tolerance of 5/10 of a foot above or below the prescribed grade and cross section shown will be permitted. For excavation for placement of geotextile, a tolerance of plus 2/10 of a foot above or 7/10 of a foot below the prescribed grade and cross section shown will be allowed. For required excavation of ditches as shown on the drawings, a tolerance of 3/10 of a foot above or below the prescribed grade and cross section shown will be permitted.

-- End of Section --
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STRUCTURAL EXCAVATION AND BACKFILL

01/06

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, materials, equipment, and performing all operations necessary for stockpiling materials, structural excavation and backfill for the box culverts, v-channels, floodwalls, pump station, railroad work and all other incidental work specified herein or as shown on the drawings.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.4 QUALITY CONTROL

The Contractor shall establish and maintain quality control for excavation operations to assure compliance with contract requirements and maintain records of his quality control for all construction operations including but not limited to the following:

(1) Equipment. Type, size, and suitability for construction of the prescribed work.

(2) Structural Excavation. Check grade, slopes, and dimensions for compliance with design sections.

(3) Grade Tolerances. Check fills to determine if placement conforms to prescribed grade and design section.

(4) Construction. Layout, maintaining existing drainage, moisture control, thickness of layers, spreading and compacting.

(5) Classification of soils, placing and compacting of structural fill, and density tests.

(6) Control Testing. The Contractor shall perform all control testing such as particle size analysis. No separate measurement and
payment will be made for control testing required in this paragraph. The Contractor shall include any and all costs for control testing in the contract prices for items of work to which the work is incidental thereto.

1.4.1 Reporting

The original and two copies of these records of inspections and tests, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Clay Backfill

Only clay fill meeting the material requirements specified in Section 31 24 00.00 12 EMBANKMENT, paragraph "Compacted Clay" shall be used.

2.1.2 Suitable From Excavation

Granular or non-granular material not classified as unsuitable as described in paragraph "UNSUITABLE MATERIALS.

2.2 EQUIPMENT

Equipment for compaction shall conform to the requirements herein and the applicable requirements of Section 31 24 00.00 12 EMBANKMENT.

2.2.1 Hand Tampers

Hand tamping shall be used in the compaction of structural fill within three feet of any floodwall or structure and where vehicular equipment cannot be used. These hand tampers should be power driven, hand operated type.

2.2.2 Alternative Compaction Equipment

The Contractor may propose for use alternative types of compaction equipment not included in these specifications. The suitability of the alternative equipment must be demonstrated to the Government Representative by a field test conducted by and at the expense of the Contractor. The alternative compaction equipment must be capable of properly compacting the soil so that no planes of weakness or laminations are formed in the fill. Additionally, the alternative compaction equipment must not detrimentally affect any adjacent structure. The field test shall consist of compacting a minimum of three layers of an area of embankment with the alternative type equipment.

2.2.3 Miscellaneous Equipment

Scarifiers, disks, spring-tooth or spike-tooth harrows, spreaders, power tampers and other equipment shall be of types suitable for the required construction. Sprinkling equipment shall be designed to apply water uniformly and in controlled quantities to variable widths of surface.
PART 3 EXECUTION

3.1 STRUCTURAL EXCAVATION AND BACKFILL

3.1.1 General

The Contractor shall make all excavations required for the construction of the flood walls. Suitable material from required structural excavation shall be used in the structural backfill. Materials determined to be unsuitable by the Government Representative shall be ordered wasted.

3.1.2 Structural Backfill

Structural backfill is defined as any soil material, which is placed within the limits of the structural excavation and the final grade as indicated on the drawings, and as herein specified. The Contractor shall fill all excavations to grades shown on the drawings. Structural backfill shall not be placed against concrete structures for a minimum of 14 days after the concrete is placed. The Contractor may at his expense place fill sooner if he furnishes and tests cylinders to demonstrate that the concrete has achieved 75 percent of its design capacity.

3.1.3 Clay Backfill

Only clay fill meeting the material requirements specified in Section 31 24 00.00 12, EMBANKMENT, paragraph "Compacted Clay" shall be used.

3.1.4 Compacted Backfill

Compacted backfill shall be compacted in accordance with Section 31 24 00.00 12, EMBANKMENT.

3.2 UNSUITABLE MATERIALS

Materials, which are classified as unsuitable structural backfill, are defined as material containing organic matter, sticks, branches, roots, brick, concrete, rock, and other debris.

3.3 FROZEN MATERIALS

Under no circumstances shall frozen earth, snow or ice be placed in the fill. The Government Representative may require the wasting of frozen material.

3.4 DRESSING

The fill shall be brought to not less than the prescribed design cross section at all points. Unreasonable roughness of surface shall be dressed out to permit fertilizing and seeding operations.

3.5 SHORING

The Contractor shall provide all necessary shoring, bracing, sheeting, underpinning, and/or supports as may be required for the construction of the intake structures, box culverts, U-channels, pump station, railroad work and other incidental work as shown on plans. A design and the method of installing the proposed shoring shall be submitted to the Government Representative for approval at least 30 days prior to its actual intended use. Upon completion of the structure, the Contractor shall remove the
shoring at the direction of the Government Representative or his representative. The void created by the shoring removal shall be backfilled and the surface area shall be treated to match the existing surface prior to the installation of the shoring. Excavations more than 5 feet deep shall be shored unless shown otherwise on the drawings. Additional requirements for shoring shall be in accordance with Section 25 "Excavations and Trenching" of EM 385-1-1.

-- End of Section --
PART 1 GENERAL

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PART 3 EXECUTION

3.1 OPERATION
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-- End of Section Table of Contents --
1.1 SCOPE

The work provided for herein consists of furnishing all plant, equipment, labor and materials; performing all operations required for designing, furnishing, installing, and operating a system to dewater the excavated area or area inside of temporary retaining structures; maintaining these areas free from water during construction operations; rewatering the area under controlled conditions at the termination of the dewatering and removing the system.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 DEFINITIONS

(1) Dewatering defines the lowering of the ground water below the slopes and bottom of the excavation to ensure dry, firm working conditions and the reduction to safe levels of any hydrostatic uplift pressures in any confined foundation strata and/or aquifers which is necessary to ensure the stability and integrity of the foundation.

(2) Dewatering system defines the machinery, equipment, and appurtenances necessary for and related to the accomplishment of dewatering, and the collection and disposal of all surface water within the protected area.

(3) Flooding of the excavation is defined as the controlled process of filling the excavation with water to a specified elevation and at a specified rate.

(4) Unwatering is defined as the process of removing all water within an excavation.

(5) Rewatering is defined as the controlled process of placing water in the completed structure and/or excavation to its naturally occurring elevation at a specified rate when the construction is completed and the dewatering system is no longer required.

1.4 DESIGN

The dewatering system shall be designed and stamped by a Registered Professional Engineer in the State of Louisiana. The dewatering system shall be designed using accepted professional methods of engineering design consistent with the best current practice.

1.5 MODIFICATIONS TO DESIGN

All modifications to the initial dewatering system design shall be designed and stamped by a Registered Professional Engineer in the State of Louisiana.
Louisiana and submitted for review and approval. The Registered Professional Engineer shall be present at the Contractor Quality Control preparatory and initial inspections. The Contractor shall, as a part of the Quality Control plan, furnish a signed statement by the design Professional Engineer stating that the installation is in conformance with the approved design.

1.6 DEWATERING REQUIREMENTS

The dewatering system shall be of a type and capacity to accomplish all requirements specified herein.

(1) The dewatering system shall be designed, installed, and operated to dewater the excavation for river stages up to and including elevation +31.50 feet NAVD88 at the construction site. The dewatering system must also include standby pumping and power supply such that a continuously operable system is available during power outages, pump failures, etc.

(2) The dewatering system shall be of such capacity that it will lower and maintain the free-water and hydrostatic pressures in the foundation and piezometric levels to an elevation at least 3.0 feet below all earth slopes and excavation surfaces lying within the area, inclusive of the interior slopes of the temporary retaining structure embankments proper. The system shall have sufficient capacity to accomplish this desired result, allowing for normal variation in soil properties and foundation conditions.

(3) The water level shall be maintained continuously as specified above so that construction operations can be performed without interruption due to wet conditions.

(4) No upward or vertical or lateral flow of ground water into the excavated area will be permitted at any time. The dewatering system shall be designed, constructed/installed, and operated at all times, including unwatering, rewatering, and/or flooding so as to prevent movement and/or piping of the foundation, excavation slopes, and fill materials. The system shall be operated as necessary during dewatering, unwatering, flooding, and rewatering so as to maintain piezometric levels, within the dewatered area, at or beneath the elevation of the water level in the excavation.

(5) The system may consist of wells, jet eductors, wellpoints, pumps, standby pumps, sumps, sump pumps, ditches, and necessary appurtenances capable, at all river stages less than or equal to the design stage defined in (1), of intercepting seepage before it exits on any interior surface or excavation face and of providing control of surface water. The system shall be operated as required in (3) above to prevent flooding filter materials and fresh concrete; and shall be designed to control a rainfall intensity two (2) inches per hour. Protection of all slopes will be required to prevent erosion under normal surface runoff and construction conditions. Slope protection may include proper drainage, mulching, vegetation, geosynthetics, etc.

(6) Unwatering of an excavation need not be accomplished by sumping alone, but may utilize sumping in addition to positive dewatering accomplished with a system meeting the requirements of subparagraph (5) above. Unwatering shall at all times fulfill the requirements of
paragraph (4) above.

(7) Rewatering and/or flooding of the area shall be accomplished by directing surface and ground water into the area. The dewatering system shall be kept operating at full capacity during such conditions, with dewatering effluent being directed into the excavation. Protection of slopes and excavation surfaces shall be provided as necessary to prevent erosion during flooding operations. No upward or lateral flow of ground water into the excavation will be permitted.

(8) Burying of headers will be allowed only in areas and to depths absolutely necessary for protection against damage at construction equipment crossings.

(9) A piezometer system shall be installed by the Contractor to monitor phreatic surface elevations to evaluate the effectiveness of the dewatering system in fulfilling the requirements specified herein. The Contractor shall make a minimum of two readings per piezometer, per 24-hour period, a minimum of 8 hours apart, based on a 7-day week. These piezometer readings, along with corresponding river stage readings, shall be recorded and reported to the Government Representative within 12 hours after they are obtained.

(10) The dewatering system shall include mechanical means, such as an in-line Venturi meter for measuring the effluent from each wellpoint segment and/or each well as well as the total effluent of the dewatering system. Devices and techniques used in measurement shall be standard in the industry. The frequency of measurements shall coincide with the requirements for piezometers stated in subparagraph (9) above.

(11) The dewatering system shall be designed, installed, and operated in a manner which will preclude removal of materials from the foundation by the pumping operation (hereafter referred to as "sanding"). After installation, each well, jet eductor, or wellpoint segment shall be individually pump tested at maximum design flow rate to verify acceptability with respect to sanding. The dewatering system shall be designed and constructed/installed so as to permit periodic measuring of sanding characteristics of each well and/or wellpoint segment. Any well or wellpoint segment found sanding at a rate exceeding 1 pint per 25,000 gallons of effluent at any time during this contract shall be replaced at no additional cost to the Government.

(12) The rate of unwatering or rewatering the excavation shall meet the Government Representative's requirements for operation, yet provide for a stable excavation.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Dewatering Plan; G

Complete dewatering design package with details of the proposed
dewatering facilities to the Government Representative for review
and approval by the Government Representative. These details must
be presented in the form of shop drawings, including the type of
system, planned layout and sizes of wells, jet eductors and/or
wellpoints, headers, including all lengths requiring burial,
collectors, ditches, piezometers, sumps and pumps; number, type,
location, elevation, proposed method of installation, and proposed
methods of testing of piezometers; facilities for measuring the
flow of water pumped from each well and/or wellpoint segment of
the dewatering system; facilities and proposed schedule for
monitoring of sanding; provisions for disposal of water from the
dewatering system; and plan of operation including flooding and
rewatering plans. This submittal shall include the design
capacity of each well and/or wellpoint segment at the design
stage, and shall be submitted no later than 60 days prior to
installation of the system. The Government Representative's
review of the Contractor's proposed dewatering facilities will not
exceed thirty (30) calendar days and will be for the purpose of
determining (1) the acceptability of the general design concept
and layout of the system; (2) the gross capacity of the system at
the design stage; and (3) the acceptability of the flooding and
rewatering plans. The design and installation procedure of the
individual components of the system need not be submitted for
review, as the performance of the complete system remains a
responsibility of the Contractor. If the Government Representative
determines, based on the above-mentioned review, that the system
appears adequate to accomplish the required results, the system
will be approved for installation. If the Government
Representative's review determines that the Contractor's proposed
dewatering facilities are either inadequate or inappropriate to
accomplish the required results, the Contractor will be so
notified in writing, and the basis for rejection will be
included. Subsequent approval of the plan for installation,
either as submitted or revised as a result of the review, should
not be interpreted as the Government accepting responsibility for
the performance of the dewatering system and shall not relieve the
Contractor of full responsibility for the proper design,
installation, maintenance, operation, and actual performance of
both the individual system components and the entire system.
After approval of installation, the Contractor shall install the
entire dewatering system and shall make no alteration to the
planned system without the prior written approval of the
Government Representative. If, during the progress of the work,
the installed dewatering system proves inadequate to meet the
requirements specified, including piezometers, the Contractor
shall, at its expense, furnish, install, and operate such
additional dewatering facilities and/or make such changes, either
in features of the system or the plan of operation, as may be
necessary to perform the required dewatering without additional
cost to the Government.

1.8 GENERAL CRITERIA

All permanent work under this contract except as otherwise specified shall
be carried on in areas free of water. The Contractor shall design,
furnish, install, operate, and maintain such facilities necessary to
accomplish the following:

(1) Collect and dispose of all surface water in the protected area regardless of source.

(2) Control and dispose of all surface water around the periphery of the excavation areas to prevent such water from entering the excavation.

1.9 QUALITY CONTROL

1.9.1 General

The Contractor shall establish and maintain quality control for all dewatering plans and operations to assure compliance with contract requirements and maintain records of his quality control for all construction operations, including but not limited to the following:

(1) Designing.

(2) Fabrication and workmanship.

(3) Installation, operation, and removal.

(4) Monitoring free water surface and piezometric elevations.

(5) Measuring effluent from dewatering system.

(6) Monitoring of sanding.

1.9.2 Reporting

An original and two (2) copies of these records and tests, as well as the corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL. Reports of operation and inspection shall include the following data: piezometric elevation, river stages, time of operation of each pump, time of operation of each wellpoint segment and/or each well, effluent discharge, sanding rates, problems encountered, proposed actions, and any other pertinent data.

1.10 INITIAL TESTING

Upon installation of the system, the Contractor shall test and evaluate the completed system to demonstrate that the system is, in fact, capable of performing the intended dewatering operation as outlined herein. This testing shall include complete falling-head tests to be conducted on each piezometer. The Contractor shall give the Government Representative 24-hour advance notice of its intention to perform testing. The documentation of results of the test shall be provided to the Government Representative within 48 hours of completion.

1.11 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
PART 3   EXECUTION

3.1   OPERATION

The Contractor shall perform dewatering and maintain the work areas in a dry condition as long as are necessary for the work under this contract. Once an area is dewatered, it shall be maintained in a dewatered condition until all work in that area is completed, unless flooding is directed by the Government Representative. In the event that flooding is deemed necessary by the Government Representative, the protected area shall be flooded in accordance with the sequence of flooding proposed by the Contractor and approved by the Government Representative. However, the Contractor shall not flood the protected areas without the approval of the Government Representative. If flooding is directed by the Government Representative, the Contractor will be compensated for damages in accordance with the applicable requirements of the General Provisions and Section 00700 Standard General Conditions. If flooding occurs because of the Contractor's fault, negligence, or convenience, all costs resulting from such flooding shall be borne by the Contractor. Commencement of dewatering subsequent to flooding will be subject to prior approval of the Government Representative.

3.2   MAINTENANCE AND SERVICING

The Contractor shall be responsible for the maintenance, servicing, and repairs of the entire dewatering system and appurtenances during the life of the contract, including replacement of any and all wells, jet eductors, wellpoints and piezometers performing unsatisfactorily.

3.3   REMOVAL

The dewatering facilities required to maintain a dry condition within the protected area shall be maintained until completion of the work within the protected area, and then shall be completely removed. However, no dewatering facilities of any kind shall be removed without prior approval of the Government Representative. All wells, jet eductors, wellpoints, pumps, and appurtenances employed in the dewatering system and all materials other than earth shall remain the property of the Contractor and shall be removed from the site of the work. All holes created by removal of dewatering facilities shall be plugged in accordance with LADOTD water well closure criteria as stated in Chapter III of LADOTD-01. Any approvals of the implementation and/or removal plans by the Government Representative do not shift the responsibility for the removal of the system from the Contractor to the Government. Nor does it relieve the Contractor of his responsibility to provide a removal plan, which comports with industry standards and prudent construction practices.

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PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, except as otherwise specified in Section 31 23 00.00 12 EXCAVATION, and performing all operations in connection with foundation preparation and construction of embankments, including reconstructing of the existing levee, conveyance channel, bypass channel and other incidental earthwork as may be necessary to complete the embankments, as shown on the drawings, and as hereinafter specified. Fill and backfill for structures are covered in Section 31 23 16.16 12 STRUCTURAL EXCAVATION, FILL AND BACKFILL.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D698 (2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

ASTM D1140 (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D2216 (2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D2487 (2011) Soils for Engineering Purposes (Unified Soil Classification System)


ASTM D4643 (2008) Determination of Water (Moisture) Content of Soil by the Microwave Oven Method


1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control for embankment construction operations to assure compliance with contract requirements, and maintain records of its quality control for all construction operations including but not limited to the following:

(1) Equipment. Type, size, and suitability for construction of the prescribed work.

(2) Foundation Preparation. Breaking surface in advance of embankment construction, and during fill placement when necessary, drainage of foundation and partially completed fill.

(3) Materials. Applicable tests, location of material testing sites.

(4) Construction. Layout, maintaining existing drainage, moisture control, thickness of layers, spreading and compacting.

(5) Grade and Cross Section. Crown width, crown slope, side slopes, and grades.

(6) Roads and Ramps. Location of temporary roads to fields or buildings, location and placement of fills for ramps in accordance with specified dimensions and grades.

(7) Grade Tolerances. Check fills to determine if placement conforms to prescribed grade and cross section.

(8) Settlement of Foundation. Location of settlement gages established or measurements taken to determine settlement, location of sudden failures.

(9) Slides. Location and limits; methods and equipment used where remedial work has been directed.

(10) Control Testing. The Contractor shall perform all control testing such as soil classification, moisture content, control compaction curves, organic content, sand content and in-place density. The results of all tests shall be reported to the Government Representative within 24 hours of sampling, except for the organic test results, which shall be reported within 48 hours of sampling. To ensure contract compliance, the Contractor shall submit the results of
the control compaction curves, in-place density tests, moisture content tests, one-point compaction tests, sand content tests, and organic content tests to the Government Representative so they can be faxed to Chief of Geotechnical Branch @ 504-862-2987. The Contractor's QC test results of in-place compaction, soil classification, moisture content, sand content, organic content, and compaction curves shall be provided to Engineering Division, Geotechnical Branch, on a regular basis throughout the contract, but no later than five (5) days of receiving results. Testing shall be performed by a Government approved testing agency, organization or field laboratory including on-site testing labs operated by QC personnel. Criteria used for obtaining Government approval shall be in accordance with ASTM E329. No additional payment will be made for control testing required in this paragraph. All costs in connection therewith shall be included in the contract unit price for "Embankment, Compacted Fill". Documentation of sampling locations for the following tests shall be clearly defined by levee station and offset and also by lift number or elevation. As a minimum, the following tests are required:

1. Soil Classification Tests. Determination of soil classification shall be in accordance with ASTM D2487. Atterberg Limits Test required for soil classification shall be performed in accordance with ASTM D4318. One Atterberg test shall be obtained from the sample material used for each control compaction curve and one shall be obtained from the sample material used for each in-place density test. If the Nuclear Method is used, the material to be tested shall come from within a radius of 12 inches of the center of the in-place density test site. The soil classification obtained from in-place density tests will serve as the basis for determining the applicable control compaction curves.

2. Control Compaction Curves - Compacted Fills. Control Compaction Curves shall be established in accordance with ASTM D698 - Laboratory Compaction Characteristics of Soil Using Standard Effort. A Compaction Control Curve will be required for each type of material from each source or a minimum of one Compaction Control Curve every 25,000 cubic yards of compacted fill placement. Where construction operations result in the blending of material, two representative Compaction Control Curves will be required for each resulting blend of material. The samples collected for the resultant blended material shall be collected from separate locations. If the borrow or source of fill material changes, new Compaction Control Curves shall be performed. Material test samples for Compaction Control Curve shall be prepared by air-dry, rewet, and cured.

3. In-Place Density Tests. In-place density tests for compacted fill material shall be made in accordance with ASTM D6938 (Nuclear Method) or ASTM D1556 and shall be made at a minimum frequency of one density test per lift per 1500 cubic yards of compacted fill placed in the levee per lift, but not less than one density test per 500 feet per lift. At least one test shall be performed in any shift that compacted fill is placed. A lift on any one side of the existing embankment will be considered one lift. The location of the test shall be representative of the area being tested or as directed by the Government Representative. For each in-place density test, the Contractor shall determine the percentage of ASTM D698 maximum dry density and the deviation from
optimum water content in percentage points (plus or minus), using
the control compaction curves for the same type of material. The
appropriate control compaction curve shall be selected by using
the one-point compaction test when available or visual soil
classification and soil classification test.

If the Nuclear Method is selected for field density testing, the
dry density shall be determined by using the value of wet density
reported by the nuclear density equipment and the value of
moisture content obtained from ASTM D2216 or ASTM D4643. The
Contractor shall not use the value of dry density reported by the
nuclear density equipment.

The Sand-Cone Method shall be used to confirm the accuracy of the
Nuclear Method. This can be accomplished by performing an initial
comparison test of the two methods at the start of construction.
If the Nuclear Method wet density is within 3 percent of the Sand
Cone Method, no correction of the Nuclear Method wet density will
be required and the testing may continue with the Nuclear Method.
The Nuclear Method wet density shall be verified throughout the
project at a rate of one Sand-Cone test for every ten nuclear
tests thereafter. If the variance at any time exceeds 3 percent, a
correction factor will be required to be determined prior to any
further testing. For comparison purposes, the nuclear and
sand-cone wet densities should represent the same layer thickness
within the testing area selected. When a nuclear density result is
in doubt, the sand-cone density test shall be used for acceptance.

4. One-Point Compaction Test. As a minimum, the Contractor
shall perform a one-point compaction test at every fifth (5th)
in-place density test. If the Nuclear Method is used for in-place
testing, every other one-point compaction test shall be performed
at the sand-cone verification test location on a sample from the
same material location as the in-place density test in accordance
with ASTM D698. The material shall be compacted at the same water
content as the field test if it is estimated to be on the dry side
of optimum laboratory water content. If the field water content
is estimated to be above the optimum water content, the
 corresponding lab sample shall be dried to an estimated water
content which is not more than 3 percent dry of the actual optimum
water content. The water content/dry density point on the
one-point compaction test shall be plotted on the family of curves
for the same soil type from the same borrow source. The
compaction control curve is estimated by projecting a curve that
is parallel to the adjacent compaction curves. The optimum water
content and maximum dry density shall be estimated from the
control compaction curve. If the laboratory data plots outside of
the available family of compaction curves, the Contractor shall
perform a complete compaction test in accordance with ASTM D698.

5. The correction factor shall be determined by conducting ten
comparison tests (five ASTM D6938 and five ASTM D1556) and
calculating the average difference (correction) for each soil type
encountered. The developed correction shall be used for adjusting
the nuclear wet density readings. The results of the in-place
density, moisture content, and one point compaction test shall be
reported to the Government Representative by the end of the
working day following the in-place density test. Moisture Content
Tests. Moisture content tests at each density test location shall
be taken to assure compliance with requirements for fill placement within the design sections as specified in paragraph "Moisture Control." Determination of moisture content shall be performed in accordance with ASTM D2216 or ASTM D4643. Determination of moisture content shall not be performed in accordance with ASTM D6938 (Nuclear Method).

6. In-Place Organic Content Tests. Organic content tests shall be taken at each in-place density test location. Limits of organic content are specified in paragraph "MATERIALS". Determination of organic content shall be performed in accordance with ASTM D2974, Method C.

7. Sand Content Tests. One sand content test shall be obtained from the sample material used for each control compaction curve and one shall be obtained from the sample material used for each in-place density test. Limits of sand content are specified in paragraph "MATERIALS". Determination of sand content shall be in accordance with ASTM D1140.

8. Additional Tests. In addition to the above frequency of tests, additional tests are required as follows:

a. Where the Government Representative has reason to doubt the adequacy of the compaction, organic content, or moisture control.

b. Where the Contractor is concentrating fill operations over a relatively small area.

c. When, in the opinion of the Government Representative, embankment materials change substantially, the Contracting Office may direct additional testing.

d. Where non-traditional compaction procedures/equipment are being used.

e. When areas are found not meeting the specified in-place density, Atterberg Limits, sand content, and/or in-place organic content requirements, the Contractor shall retest at no additional cost to the Government after corrective measures have been applied.

(11) Compliance Surveys. Submit plotted cross sections at intervals and locations corresponding to the Government's original survey. The primary, secondary, and temporary benchmarks used shall be listed on each compliance survey. Upon completion of suitable reaches of embankment, the contractor shall perform, plot, and submit compliance cross section surveys at a maximum of 50-foot intervals and all P.I.'s, curve P.C.'s, P.T.'s, levee transitions, and breakpoints. All compliance surveys of levees that are adjacent to other structures (ex. floodwall, sheetpile) shall include the transitions to those structures in the surveys, whether the contractor is responsible for the transition or not. The limit of the transitions shall be the end of any armoring protection on the structure side, and in the case where there is no armoring, 50 feet on the structure side.

All sections shall be taken at locations corresponding to the Government original survey. They shall be plotted by the Contractor on a minimum scale of 1 inch equal to 10 feet horizontally, and 1 inch equal to 5 feet vertically, with the theoretical design cross section.
and allowable grade tolerances superimposed thereon. Additionally, the contractor shall perform, plot, and submit a levee centerline profile with shots taken at a maximum of 20-foot intervals. The plotted cross sections and profile shall be submitted to the Government Representative for review. Electronic survey data shall be submitted to the Government Representative within 48 hours of completion of surveys. Survey notes shall be provided with the plotted sections for each survey taken by station, with offset and elevation. After the Government Representative accepts and verifies the survey, the contractor shall provide an electronic copy of survey files to the Government Representative.

(12) Quantity Surveys. Provide plotted cross sections of all surveys for progress payments at a maximum of 50-foot intervals. Perform, plot and submit partial levee cross sections at a maximum of 50-foot intervals for determining progress payments. Plot on the same scale noted above.

1.4.2 Reporting

The original and two (2) copies of these records of inspections and tests, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.5 QUALITY ASSURANCE

As a control, the Government will perform assurance and check tests for maximum dry density for all materials in accordance with ASTM D698. If values for maximum dry density as determined by the Contractor and as determined by the Government do not agree, the Government will determine the values to be used. The Government will also perform check and assurance testing of the other control testing required by the Contractor in paragraph "General", subparagraph (10).

1.6 EQUIPMENT

1.6.1 General

Compaction equipment shall be capable of properly compacting the soil so that no planes of weakness or laminations are formed in the fill. Equipment shall be capable of compacting a layer of soil not less than 12 inches thick to the requirements specified herein and shall be operated at speeds not to exceed 3.5 miles per hour.

1.6.2 Hand Tampers

Hand tamping shall be used in the compaction of fill within three (3) feet of any structure or other drainage feature and near same where vehicular equipment cannot be used. These hand tampers shall be of the power driven, hand operated type.

1.6.3 Miscellaneous Equipment

Scarifiers, disks, spring-tooth or spike-tooth harrows, spreaders, power tampers, and other equipment shall be types suitable for construction of embankment and berms.
1.6.4 Sprinkling Equipment

Sprinkling equipment shall be designed to apply water uniformly and in controlled quantities to variable widths of surface.

1.7 EMBANKMENT AND BERM MATERIALS

1.7.1 General

The embankment and berms shall be constructed of earth obtained from the borrow areas, the new conveyance channel and other required excavations as prescribed in Section 31 23 00.00 12 EXCAVATION and to the extent shown on the drawings.

1.7.2 Moisture Control

1.7.2.1 Moisture Control - Compacted Fill

The Contractor shall control the moisture content of the embankment material. The optimum moisture content shall be determined in accordance with paragraph "General", subparagraph (10). The Contractor shall perform the necessary work in moisture control to bring the borrow material within the moisture content range specified in paragraph "Compaction".

Borrow material is considered too wet to be placed directly upon the levee compacted fill footprint, if it has a moisture content greater than 10 percentage points above the optimum moisture content resulting from the Standard Proctor Compaction Test ASTM D698. If the borrow material is too wet, it shall either be stockpiled and allowed to drain and/or the wet material shall be processed by disk ing and harrowing, if necessary, until the moisture content is reduced sufficiently, before being placed within the levee or berm(s) section. When it is discovered that wet fill has been placed over existing levee or newly constructed compacted fill footprint, the incident layer and previous layer will be tested in a minimum of two locations for density and moisture compliance. If the top or contact surfaces of a partially filled section becomes too wet to permit suitable bond between these surfaces and the additional backfill to be placed thereon, the wet material shall be scarified and permitted to dry, assisted by disk ing or harrowing. The material shall be recompacted in accordance with the applicable requirements of paragraph "Compaction".

Borrow material is considered too dry to be placed directly upon the levee and berm(s) compacted fill footprint, if it has a moisture content greater than 10 percentage points below the optimum moisture content resulting from the Standard Proctor Compaction Test ASTM D698. If the borrow material is too dry, it shall be prewet in the source area, before being placed within the levee or berm(s) section. If the top or contact surfaces of a partially filled section becomes too dry to permit suitable bond between these surfaces and the additional fill to be placed thereon, the Contractor shall loosen the dried materials by scarifying, disk ing, or other approved methods, and shall recompact this layer in accordance with the applicable requirements of paragraph "Compaction". No additional payment will be made for any moisture control required in this paragraph.

The Contractor shall clearly define the processing areas with stakes, flagging, etc. The Contractor shall maintain minimum acceptable distances between the processing area and other areas, canals, berms, roadways, etc. The Contractor shall not process material within 100-ft. of existing floodwalls or utility crossings.
Once the Contractor no longer has use of the processing area, the Contractor shall remove any remaining material within the processing area to the elevation of the surface as surveyed in the pre-processing survey. The Contractor shall test and verify that the in-place density and moisture content of the upper 12 inches of the berm material are as specified in the paragraphs "QUALITY CONTROL" and "COMPACTION". If material does not meet specifications, the Contractor shall take remedial action as described above.

1.7.2.2 Moisture Control - Uncompacted Fill

There are no moisture control requirements for uncompacted fill. Uncompacted fill shall be placed at its natural water content.

1.7.3 Compaction

The first and each successive layer of compacted fill material shall be compacted to at least 90 percent of maximum dry density as determined by ASTM D698 (Standard Proctor Compaction Test) at a moisture content within the limits of plus 5 to minus 3 percentage points of optimum moisture content determined from ASTM D698. For the first layer above the geotextile, a tractor having a ground pressure no greater than 4.7 plus or minus 0.2 psi shall be used to spread and then compact the layer.

1.7.4 Dressing

The entire embankment and berm, including topsoil where specified, shall be brought to not less than the prescribed design cross section, within allowable tolerance, at all points. Unreasonable roughness of the surface shall be dressed out to permit fertilizing, seeding and mulching operations.

PART 2 PRODUCTS

2.1 MATERIALS

The embankment shall be constructed of earth materials naturally occurring or Contractor blended. Materials that are classified in accordance with ASTM D2487 as CL or CH with less than 35% sand content are suitable for use as embankment fill. Materials classified as ML are suitable if blended to produce a material that classifies as CH or CL according to ASTM D2487. All fill materials shall be free from masses of organic matter, sticks, branches, roots, and other debris including hazardous and regulated solid wastes. As earth from the designated excavation areas may contain excessive amounts of wood, isolated pieces of wood will not be considered objectionable in the embankment provided their length does not exceed 1 foot, their cross-sectional area is less than 4 square inches, and they are distributed throughout the fill. Not more than 1 percent (by volume) of objectionable material shall be contained in the earth material placed in each cubic yard of the levee section. Pockets and/or zones of wood shall not be placed in the embankment. The Contractor shall notify the Government Representative whenever the in-place Plasticity Index of the material is 15 or less. Materials placed in the section must be at or above the Plasticity Index of 10. Materials placed in the section must be at or below organic content of 9 percent by weight, as determined by ASTM D2974, Method C. Materials placed in the section must contain less than 35 percent sand content by weight, as determined by ASTM D1140.
PART 3 EXECUTION

3.1 EMBANKMENT AND BERM FOUNDATION PREPARATION

3.1.1 Foundation Preparation

After clearing and grubbing and any required excavation of the embankment, test pits and other similar cavities and depressions shall be broken down, where so directed, to flatten out the slopes. Areas on which geotextile is to be placed shall be dressed, to provide a smooth surface within the allowable tolerance, and left unbroken. If for any cause, this broken surface becomes compacted in such a manner that, in the opinion of the Government Representative, a plane of seepage or weakness might be induced, it shall again be adequately scarified before depositing material thereon. All scarifying and breaking of ground surface shall be done parallel to the centerline of the levee.

3.1.2 Drainage

The foundation receiving fill provided for in Section 31 23 00.00 12 EXCAVATION, and all partially completed fill shall be kept thoroughly drained.

3.1.3 Frozen Ground

No fill shall be placed upon frozen ground.

3.2 EMBANKMENT AND BERM CONSTRUCTION

3.2.1 Compacted Fill

The location and extent of the compacted fill is shown on the drawings. Compacted fill shall not be placed in water. The materials for compacted fill shall be placed or spread in layers, the first or bottom layer and the last two layers not more than 6 inches in thickness and all layers between the first and the last two layers not more than 12 inches in thickness prior to compaction except the first layer on top of the geotextile shall be 15 inches, thick as specified in Section 31 05 19.04 12 SEPARATOR GEOTEXTILE, for details see drawings. Layers shall be started full out to the slope stakes and shall be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction. Areas on which geotextile is to be placed shall be dressed out and leveled to the grade indicated on the drawings. When placing fill on the geotextile, mechanical equipment shall not be allowed to come in contact with the geotextile in any way. Requirements for benching into the slope of the existing embankment are required in order to place and compact the material in horizontal layers as described on the drawings. Benching shall consist of excavating the existing levee embankment as shown on the drawings and described herein. The vertical face of the existing embankment resulting from the benching operation shall be a minimum of 1 foot in height but shall not exceed 2 feet in height as shown on the drawings. Material excavated from the benching operations shall be used as compacted fill. When the surface of any compacted layer is too smooth to bond properly with the succeeding layer, it shall be adequately scarified before the next layer is placed thereon. Layers of fill adjacent to and above the geotextile shall be placed as specified in Section 31 05 19.04 12 SEPARATOR GEOTEXTILE.
3.2.2 Uncompacted Fill

The location and extent of the uncompacted fill is shown on the drawings. Uncompacted fill shall be placed in approximately horizontal layers not exceeding 3 feet in thickness. The layers shall be uniformly spread, distributed, and otherwise manipulated during placement to such an extent that individual loads of material deposited on the fill will not remain intact, and large, open voids in the fill will be eliminated. Layers shall be started full out to the slope stakes, and shall be carried in lifts approximately horizontal and parallel to the centerline with sufficient crown or slope to provide satisfactory drainage during construction. Lifts shall be placed in a manner that prevents shrinkage cracks and open voids from developing in previously placed lifts. Where material must be placed in water, it shall be dumped therein until it reaches an elevation 1.0 foot above the water surface, or until a stable fill surface is obtained before layer construction will be required. The material deposited under water shall be placed in such a manner as to ensure that any soft material will be forced progressively outward from the section and not be trapped within the base of the embankment.

3.3 EMBANKMENT WORK ADVANCEMENT

The Contractor shall prosecute the embankment work such that no more than 5,000 linear feet of levee shall be under embankment construction at any time between the limits of the approved levee cross section that has been fertilized, seeded and mulched and the farthest extent of levee clearing ahead of the embankment work. If the Contractor elects to perform embankment work in multiple locations within the total contract length, the sum of the lengths of the multiple embankment construction locations allowed shall not exceed the above given total length of 5,000 linear feet unless approved by the Government. The limits of embankment work for each of the multiple locations as they fall within the total contract length, shall be between the limits of the approved levee cross section that has been fertilized, seeded and mulched and the farthest extent of levee clearing ahead of the embankment work as pertinent to that particular location.

3.4 CROSS SECTIONS AND ZONING OF MATERIALS

3.4.1 Embankment Sections

Unless otherwise specified, the dimensions and slopes shall conform to the applicable cross sections including the allowable tolerance, shown on the drawings.

3.4.2 Zoning of Materials for Levee Construction

In general, the levee section including berms shall be homogeneous; however, where materials of varying permeabilities are encountered in the borrow areas, the more impervious material shall be placed toward the floodside slope, and the more pervious material toward the protected side slope.

3.4.3 Berms

Berms shall be constructed at the locations and to the grade and cross section shown on the drawings.
3.5 ACCESS ROADS, RAMPS AND CROSSINGS, RUNWAYS, AND DETOURS

3.5.1 Access Roads

3.5.1.1 Criteria

Access roads shall be located as indicated on the drawings. They shall be constructed by the placement of fill as specified in paragraph "Compacted Fill," shall be maintained in good condition throughout the contract period and restored to pre-construction conditions upon completion of the levee construction. The pre-construction and post-construction conditions shall be verified/documented by the use of Contractor furnished surveys and/or videos at the direction of the Government Representative. The Contractor should also be aware that truck routes and truck speed limits are subject to change and it should check with the appropriate state and/or parish officials for the applicable regulations. The Contractor shall furnish and use equipment (i.e., front-end loaders and street sweepers) as necessary to continuously keep any public street used free and clean of mud and other debris resulting from its hauling operations. Payment for this work will be made at the contract lump sum price for "Temporary Detour and Access Ramps".

3.5.1.2 Temporary Roads

At locations shown on the drawings where existing roads are destroyed because of the work required under this contract, the Contractor shall provide temporary roads to give access during the construction period. The temporary roads shall be constructed by placement of fill as specified in paragraph "Compacted Fill." The temporary roads shall be removed after permanent access has been provided. No separate payment will be made for this work.

3.5.1.3 Watering

The Contractor shall water down the access roads that are within the construction easement area as necessary to keep dust from being blown or drifting into the adjacent areas. The Contractor shall be responsible for providing a minimum 500-gallon capacity water truck designed to apply water uniformly in controlled quantities over variable widths of surface to control dust during construction.

3.5.1.4 Speed

Except in an emergency, all vehicles operating within the construction easement area shall not exceed 5 mph.

3.5.2 Ramps and Crossings

3.5.2.1 Criteria

Ramps and crossings shall be constructed at the locations shown on the drawings by placement of fill as specified in paragraph "Compacted Fill". Ramps shall be constructed only by adding material to the levee crown and slopes. Ramps shall have a 10-foot crown width, 1V-on-10 H crown slope, and 1V-on-3 H side slopes or as shown on the plans. Material used for ramp construction will be paid in the contract unit price for "Embankment".
3.6 DITCHES AND DEPRESSIONS

All sloughs, ditches, or depressions beyond the limits of the levee and/or berm foundation but within the rights-of-way shall be filled with embankment material to the natural surface of the ground or to a height sufficient to ensure drainage after shrinkage of the fill, whichever is higher. The material for the fill shall be placed as specified in paragraph "Uncompacted Fill."

3.7 GRADE TOLERANCES

All embankments shall be constructed to the design grade and cross section shown on the drawings. For compacted fill, at all points, a tolerance of 3/10 of 1 foot above the prescribed design grade and cross section shown will be permitted in the final dressing provided that the crown of the levee drains, there are no abrupt humps or depressions in surfaces or bulges in the width of the crown, and the side slopes are uniform. Any partial fill material temporarily placed within the design section shall not exceed the design grade or design slopes of the embankment by more than 1 foot, and shall have side slopes not steeper than 1 V on 3 H.

3.8 SETTLEMENT OF FOUNDATION

3.8.1 Additional Fill

Should the Contractor desire payment for placing additional fill due to foundation settlement during construction, it shall furnish and install settlement gages for determination of such settlement. Prior to placing fill material, each gage shall be installed on the prepared foundation of the location shown on the applicable typical cross section at intervals not to exceed 1,000 feet, and shall be maintained during construction. Settlement gages at each end of the work shall be placed within 300 feet of the upper and lower limits of the work. Each gage shall be set on a smooth level surface on undisturbed ground or top of the geotextile where applicable. Leveling of gage beds shall be accomplished by removing the minimum amount of earth necessary to produce an even foundation and in such manner that the density of gage beds will remain at the same density as the undisturbed adjacent ground. Burying the settlement gage below the existing ground surface will not be permitted. Leveling of gage beds by the addition of fill will not be permitted. The type of gage used shall be as shown on the drawings. The Contractor shall determine elevations of the gages prior to placing fill material, and again within 72 hours after compliance cross sections have been taken over the completed embankment at the sites of the gages to determine settlement of the foundation. The 72-hour requirement is an absolute pre-condition for payment for settlement of the foundation. The initial and final elevation of the gages will be verified by the Government Representative at the site. Measurement of additional fill material placed due to settlement of the foundation will be as stated in paragraph "MEASUREMENT AND PAYMENT". Installation of and measurement on gages shall be at the option and expense of the Contractor. When the settlement gage is located by boring with rotary drill, the drill hole shall be backfilled with embankment material and tamped throughout. At the Contractor’s option, the drill hole may be filled with a neat cement-grout tremied from the bottom of the drill hole to the top of the drill hole. If a rotary drill is used in locating the settlement gages, it shall be advanced no closer than two feet of the anticipated settlement gage elevation. The elevation of the settlement gage shall then be determined with a sounding rod.
3.8.2 Failures

In clearly established cases of sudden failure of the foundation, (1) where no provision has been made for the measurement of settlement, there will be no measurement made for settlement; (2) where settlement measuring devices have been installed, but the nature of settlement is such as to destroy their utility, the settlement shall be determined from the average elevation of the nearest surviving settlement plates on each side of the failure or, if necessary, the settlement plate nearest the failure. For hydraulic fills, other methods that are mutually agreeable will be used to measure settlement.

3.8.3 Postpone Operations

Where settlement of the foundation develops to such an extent as to make it inadvisable, in the opinion of the Government Representative, to continue to add material, and advisable in its opinion, to postpone until a considerably later date all attempts to bring that portion of the embankment to full grade and cross section, the Government Representative shall have the right to omit further work on that portion of the embankment and to accept it as completed.

3.9 SLIDES

Should a slide occur in any part of the embankment during its construction, or after its completion, but prior to its acceptance, the Contractor shall, upon written order of the Government Representative, either cut out and remove the slide from the embankment and then rebuild that portion of the embankment, or construct a stability berm of such dimension, and placed in such manner, as the Government Representative shall prescribe. In case the slide is caused through fault of the Contractor, the foregoing operations shall be performed at no additional cost to the Government. In case the slide is not the fault of the Contractor, the repair shall be made by an equitable adjustment as per requirements in Section 00700 Standard General Conditions, Article 10. The method of slide correction will be determined by the Government Representative.

3.10 SETBACK/SET FORWARD LEVEES

Where setback or set forward levees are constructed of material borrowed from the existing controlling levee, it is imperative that a continuous and closed line of protection be maintained at all times. A minimum interim grade is shown on the drawings, and the work shall be so planned and executed that as material is removed from the existing levee and placed in the new levee, the minimum grade is maintained along a continuous and closed line. In the event the Contractor's method of construction requires tie-in embankments in order to maintain the minimum grade along a continuous and closed line, such tie-in embankments shall be constructed at the Contractor's expense. Embankment for tie-in levees shall be placed and compacted in accordance with paragraph "Compacted Fill" and shall have a cross section not less than the cross section of the existing controlling levee.

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10/09

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PART 1   GENERAL

1.1   SCOPE

The Contractor shall furnish all labor, equipment, and materials necessary to conduct ground improvement by the deep mixing method hereinafter referred as DMM, site restoration, and associated testing, monitoring, sampling, and recording. Partial payment for production elements will only be permitted once they are shown to meet the criteria of paragraph "ACCEPTANCE CRITERIA".

Ground treatment patterns based on alternative DMM technology and/or different column diameters will be considered, provided these patterns satisfy requirements for minimum replacement ratio, specified unconfined compressive strength, minimum panel width, minimum panel depth, minimum overlap of adjacent columns and maximum clear space between panels shown on the project plans and described in this specification. Alternative ground treatment patterns shall include a Quality Control Plan which shall be submitted to the Government Representative for review.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 39 (2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens


ASTM D 2113 (2008) Rock Core Drilling and Sampling of Rock for Site Investigation

1.4 DEFINITIONS

1.4.1 Soil-Cement Column

A vertical cylinder of soil-cement constructed by treating soils in-situ by deep mixing technology. The soil-cement column is formed by a mixing shaft guided by a lead mounted on a crawler base machine. As the mixing shaft is advanced into and/or withdrawn from the soil, grout is pumped through the hollow stem of the shaft and injected into the soil from ports along the shaft or near the shaft tip. The grout consists of Portland cement, slag, other binder, water, and may contain other specific additives. Mixing tools (blades and/or auger flights) on the shaft must be capable of thoroughly blending the soil with the cement grout to produce a uniform soil-cement column that remains in the ground. The mixing shaft is positioned so as to overlap one another to form continuously mixed overlapping columns. The process is then repeated to form a continuous shear panel of interconnected columns.

1.4.2 Multi-Column Element

A vertical prism of soil-cement formed by two or more overlapping soil-cement columns. Multi-column elements are installed simultaneously using a rig with two or more mixing shafts that form overlapping soil-cement columns. A specific case of a multi-column element is a dual-column element which is installed using a rig with two mixing shafts.

1.4.3 Element

A vertical prism of soil-cement installed using deep mixing technology that is a component of a shear panel or a separate prism. A single soil-cement column is an element if it is installed with a single mixing shaft rig. A multi-column element is considered an element when installed with a multi-mixing shaft rig. A dual-column element is an element when installed with a dual mixing shaft rig.

1.4.4 Primary Element

An element installed through soil only, and not in contact with other elements or shear panels. Primary elements are installed prior to secondary elements.
1.4.5 Secondary Element

An element installed between and overlapping and connecting primary elements. Secondary elements are installed after the primary elements.

1.4.6 Shear Panel

A continuous interconnected and overlapped series of primary and secondary elements that extends vertically through the soil to be stabilized by DMM.

1.4.7 Binder

Any type of pozzolanic material such as Portland cement, blast furnace slag cement, or flyash.

1.4.8 Admixture

Any type of dispersant, fluidifier, or retarding agent.

1.4.9 Cement Grout

Homogenous mixture of binder, admixtures, and potable water.

1.4.10 Soil-Cement

Uniform mixture of cement grout and in-situ soils.

1.4.11 Recycled Embankment Material (REM)

All materials (spoils) including, but not limited to, liquids, semi-solids, and solids that are discharged above ground surface during soil-cement mixing.

1.4.12 Penetration Rate

Vertical movement per unit of time of the mixing tool during penetration.

1.4.13 Obstructions

Natural, man-made, or man-placed objects or materials that interrupt or impede element installation. Obstructions may include, but are not limited to rubble, utilities, logs, and tree stumps. The Government Representative shall be notified immediately upon encountering an obstruction.

1.4.14 Binder Factor

The weight of dry binder in pounds introduced into the ground per cubic yard of soil.

1.4.15 Grout Injection Rate

The amount of grout injected per minute during penetration and withdrawal expressed in gallons per minute (gpm).

1.4.16 Water-Binder Ratio

The ratio of weight of water to dry weight of binder used in the cement grout mix design.
1.4.17 Replacement Ratio

The area replacement ratio (As), as defined in Filz and Templeton (2009), pages 7 and 8. Also the ratio of the effective width of a shear panel to the center-to-center spacing of the shear panels.

1.4.18 Core Recovery

The length of recovered core divided by the length of core run, expressed as a percentage, during coring of elements.

1.4.19 Core Samples

Pieces of intact core recovered during coring of elements to evaluate uniformity and strength. Some core samples selected by the Government Representative will be tested for strength and unit weight.

1.4.20 Unimproved Soil

Unimproved soil consists of unmixed soil the full diameter of the core sample, or earth material treated by deep mixing technology that does not have an unconfined compressive strength of at least 15 psi 28 days after mixing based on unconfined compressive testing. Any material not recovered during coring will be considered unimproved soil.

1.5 SUBMITTALS

Submittals shall be reviewed and stamped by a licensed professional engineer except for survey data which shall be stamped by a licensed professional engineer or registered land surveyor. Engineer should be licensed in the State of Louisiana. Unless otherwise stated, all submittals shall include an original and two copies and be sent to the Government Representative. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Experience Profile; G

Detailed experience profile to establish that the requirements for 5 years of experience with deep mixed element installation for the Contractor and Operator have been met in accordance with paragraph "Contractor's Qualifications".

Experience/Training Records; G

Experience and/or training records of operators of deep mixing column equipment and of on-site supervision of the Contractor's operations. The experience shall be specific to the type of ground improvement method being utilized by the Contractor for this contract.

Preconstruction Testing; G

Details and results of bench scale testing, test columns, and any additional preconstruction field testing conducted by the Contractor which may be relevant to the successful execution of this Contract.
Sample of Daily Production Reports

A Sample Daily Production Report meeting the requirements of "Daily Production Report" of Section SD-06.

Quality Control Program Plan

A description of the Quality Control (QC) Program Plan including:

a. A detailed outline of the QC Program to be undertaken each day during production to confirm the mix design and cement grout volume achieves specified performance requirements.

b. Details of procedures to obtain, form, preserve, cure, and transport soil-cement samples.

c. Measures to be implemented each day during soil-cement stabilization to monitor, modify, record and control water/binder ratios, cement grout injection pressures and quantities, mixing tool rotational speeds, mixing tool down pressures, mixing tool penetration and withdrawal rates, motor amperage or hydraulic pressure variations with depth, and other related aspects of the deep mixing stabilization process.

Test Means and Methods

Details of all test means and methods proposed by the Contractor to verify that each element meets the compressive strength as specified in paragraph "Acceptance Criteria". The Contractor shall be required to conduct tests on each element selected for testing by the Government Representative. Tests include coring of elements and conducting laboratory compression testing.

SD-02 Shop Drawings

Additional Subsurface Investigation

The Contractor shall submit a boring location plan, soil boring logs, and laboratory results as part of the additional subsurface investigation as outlined in paragraph ADDITIONAL SUBSURFACE INVESTIGATION.

Soil/Cement Stabilization

Submit shop drawings including sequence and time schedule of all DMM operations. Drawing locations of all proposed elements shall be shown on a drawing not smaller than 1 inch = 20 feet scale to show the details of the layout required to satisfy the geometries required. The center of each proposed element location shall be numbered and shown on the drawing and dimensioned to the Contractor's established site-specific coordinate system and other survey baselines that the Contractor intends to use for layout and location. The sequence of element installation shall be in accordance with paragraph "INSTALLATION OF DMM ELEMENTS".

DMM Element Sequence Plan;

The Contractor shall submit a plan showing the sequence of
element installation to be approved by the Government Representative.

If an alternate design is proposed, or work in addition to that shown in the drawings is proposed, such as for temporary work pads, stockpiles, or excavations, the plan shall detail sequencing and methods to prevent damage to the adjacent utilities and structures as shown on the drawings or identified by Contractor's pre-construction survey. The plan shall also detail the sequencing of element installation to prevent creating weak areas of instability because of the time required for the elements to cure during construction. Included with the plan shall be calculations, stamped by a registered professional engineer, verifying that the adjacent structures will remain stable as a result of the Contractor's element installation. If any structures are damaged by the Contractor during construction, the Contractor shall be responsible for any and all costs associated with repair or replacement of these structures.

Remedial Measures;

Submit the original and two (2) copies to the Government Representative of proposed remedial measures for panels not meeting the acceptance criteria. Remedial measures plans shall show the location, depth, means of installation, control testing for placement panels or elements, additional testing proposed for panels not meeting the acceptance criteria and other details including the schedule to complete the remedial measures.

SD-03 Product Data

Equipment

Description of equipment to be used to penetrate the existing ground conditions and to install elements. Include details and catalog-cut sheets for all soil-stabilization equipment for storing dry materials, proportioning, mixing, and injecting and mixing cement grout, and all ancillary equipment.

If an alternate design is proposed, or work in addition to that shown in the drawings is proposed, such as for temporary work pads, stockpiles, or excavations, Contractor shall submit calculations of the induced stresses on adjacent utilities and structures as shown on the drawings or identified by the Contractor's pre-construction survey, estimates of anticipated movement, and a monitoring plan for these existing structures. If these structures are damaged by the Contractor during construction, the Contractor shall be responsible for any and all costs associated with repair or replacement of these structures. The Contractor shall also provide global slope stability analyses showing that his equipment will not lower the Factor of Safety of any existing slopes or embankments below 1.30 using Spencer's method of analysis.

Mix Design

Mix designs including: binder factor that demonstrates that the cement grout mix will obtain the unconfined compressive strength specified in paragraph "ACCEPTANCE CRITERIA". Also submit details
of cement grout mixture, cement grout flow rates, auger/mixing tools rotational speed, auger down pressure, and auger penetration and withdrawal rates. Any proposed deviations from the submitted mix design throughout the course of construction shall be resubmitted for the Government Representative's approval.

SD-06 Test Reports

Metering Equipment

Calibration test results for metering equipment. Equipment and measuring devices requiring calibration shall be identified in the Quality Control Plan. Calibrations shall be submitted prior to commencing work and at succeeding intervals as specified by the manufacturers, but no less than every 120 days of operation throughout the job.

As-Built Field Measurement Data

By the end of the second day following each work shift, the Contractor shall submit to the Government Representative as-built field measurement data indicating as-built plan locations of each deep mixed element including: the element center (per site specific coordinates), the element plan dimensions, elevation of the top and bottom of the element, and verticality data of each element. The submittal shall be presented in both paper and electronic form and demonstrate the installed elements have achieved the required plan area coverages, overlaps, and locations.

Control Testing

Control testing is the unconfined compressive testing of core samples performed in accordance with paragraph "Contractor Sampling and Preconstruction Testing".

The original and two copies of the control testing records, as well as the records shall be furnished to the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

Daily Production Reports

By the end of the day following each work shift, the Contractor shall submit Daily Production Reports for each work shift to the Government Representative in electronic format. Daily Production Reports shall be filled out and signed by the deep mixing firm's field superintendent and the Contractor's field superintendent at the end of every work shift. The reports shall contain, but not be limited to, the following information:

a. Day, month, year and time of work shift (beginning and end); names of field superintendent in-charge of the work for deep mixing firm and the Contractor, a list of all workers' names associated with each deep mixing rig, each deep mixing rig identification number and model, other deep mixing equipment supplying each rig in operation during the shift and specific activities of each rig.

b. The location of each completed deep mixed element installed
during the work shift by each rig on a plan of suitable scale not smaller than 1 inch = 10 feet to clearly show the location of the elements installed during the shift.

c. Time and date of beginning and completion of each element.

d. Water/binder ratio, cement grout injection volumes, mixing tool rotational speeds, and penetration and withdrawal rates, amperage for rigs with electric motors, and hydraulic pressure for rigs with hydraulic motors, for each deep mixed element installed during the shift. To each log must be appended the computer generated report of each element's installation characteristics as noted in SD-06, (l).

e. Other pertinent observations including, but not limited to: cement grout escapes, ground settlement and/or heave, collapses of the deep mixed element, and any unusual behavior of any equipment during the deep mixing stabilization process.

f. Date, time, plan location, and elevation and other details of DMM samples or strength tests taken during work shift, specific gravity tests, and the name of the person responsible for obtaining the deep mixed samples or conducting testing.

g. Details of all binder materials delivered to site, plus a reconciliation showing amount actually injected.

h. Summary of any downtime or other unproductive time, including time, duration, and reason.

i. Detailed results of all testing, sampling or other observations relating to the material of each treated zone tested.

j. Description of corrective action taken when cement grout injection quantities fall below the Contractor's submitted quantities.

k. Graphical representation of real-time monitoring of each element indicating depth versus the following items for the entire length of each element in increments no greater than 3 feet: mixing tool penetration and withdrawal rates; mixing shaft rotation rates; cement grout injection volume; and amperage or hydraulic pressure of motors.

1.6 PERFORMANCE REQUIREMENTS

The Contractor shall install deep mixed elements to stabilize soft clay, peat, and organic clay, foundation soils at the locations and configurations shown on the drawings and specified herein, meeting all requirements as defined in paragraph "Acceptance Criteria" specified in this section.

1.6.1 Alternative Designs

Alternate DMM designs different from those shown in the plans will be considered. Alternate designs shall meet the criteria of this document plus the following criteria.

a. Mass Soil Stabilization (MSS) soil improvement techniques may be
considered as an alternative to DMM. If considered, shear panel criteria may not be applicable.

b. Shear panels shall be oriented in the same directions as the shear panels shown in the drawings, and shall meet the internal and external stability requirements in Filz and Templeton, 2009.

c. The minimum replacement ratio for shear panels unless otherwise shown in the plans shall be 0.3. The replacement ratio shall not include the contribution of elements between shear panels at the centerline of the new levee.

d. The minimum soil-cement column diameter for single or multi-column elements shall be 2.5 feet.

e. The clear spacing between panels below the new levee centerline and 5 feet either side of the centerline, shall be no more than 5 feet.

f. The top and bottom elevations of the shear panels and the shear panel length and position relative to the levee centerline shall be as shown in the plans.

g. The top and bottom elevations of elements below the centerline of the new levee, if required to provide a minimum clear spacing between panels of 5 feet, shall be as shown in the plans.


1.7 CONTRACTOR QUALIFICATIONS

The Contractor shall demonstrate an experience profile and experience/training records containing a minimum of 3 years experience in ground improvement and shall provide at least one equipment operator having a minimum of 3 years experience with the equipment and with ground improvement construction. The experience shall be specific to the type of ground improvement method being utilized by the Contractor for this contract. The Contractor shall also provide a site superintendent and/or site engineer with a minimum of 5 years experience in ground improvement construction. The experience shall be specific to the type of ground improvement method utilized by the Contractor.

1.8 QUALITY CONTROL

1.8.1 General

The Contractor shall implement a Quality Control Program Plan (QC) to permit the confirmation that the ground treatment methods performed are applied in accordance with this specification and achieve the specified Acceptance Criteria. The QC Plan shall also be implemented to generate and maintain records of the quality control measures for construction operations including, but not limited to, the following:

a. Equipment. Type, size, and suitability for the construction of the prescribed work.
b. Materials. Compliance with this specification and approved submittals.

c. Installation.

1) Continuous injection, mixing vertically full depth, with computer monitoring.

2) Geometric Tolerances. Horizontal alignment of the elements shall be within 2 inches of the planned location as measured at the ground surface. The horizontal overlap between primary and secondary elements and the mixing shaft overlap within primary elements for multi-shaft rigs shall be as shown on the plans. The inclination of the columns (vertical alignment) shall be within 0.8 percent of vertical as measured at the ground surface.

3) The minimum length of the shear panels shall be within ±1.0 percent of the shear panel length shown in the plans.

4) Top of shear panels shall be at least as high as the top elevation shown in the plans.

5) Bottom of shear panels shall be no higher than the bottom elevation shown in the plans.

d. Contractor Sampling and Preconstruction Testing

The Contractor shall submit details of all the proposed test means and methods for the below testing requirements.

1) Control Testing. Unconfined compression tests shall be performed for core samples. Unconfined compression testing shall be performed in accordance with ASTM D 2166, ASTM D 1633 or ASTM C 39.

2) Coring. Three percent of the total installed elements shall be cored and tested. Additional coring may be done at the discretion of the Government Representative if significant deficiencies are found based on the planned testing. The Government Representative will select the elements to be cored. Contractor shall perform core sampling of hardened soil-cement in accordance with ASTM D 2113. The core shall be obtained for the full depth of the element. The minimum core recovery shall be 80 percent. Core samples intended for strength tests should be prepared in accordance with the "Special Care" requirements of ASTM D 5079, Section 7.5.2, and stored in a moist room or other curing facility. If recovery is lower than required, the Government Representative may require additional coring at Contractor's expense. The cores shall be made available for review by the Government Representative. Contractor shall determine the core recovery for each core run. For core sampling, the sample diameter shall be at least 2.5 inches and core runs shall be no more than 5 feet in length. Contractor shall grout each core hole from the bottom up with neat cement grout (water/binder ratio of no greater than 1:1) at the completion of each core hole using tremie methods.

3) The Government Representative shall select up to 10 core samples from each coring location for strength testing. Samples will not be selected in the top 3 feet of the element. The test
specimens shall have a length to diameter ratio of 2. Unconfined compression tests shall be performed on each core sample at approximately 28 days after element installation.

e. Specific Gravity

The specific gravity of the cement grout shall be determined during the validation program and during production DMM for double-checking grout proportions. Contractor shall check the specific gravity of the cement grout at least twice per shift per rig using the methods outlined in ASTM D 4380. The specific gravity measurements shall be indicated on the Daily Quality Control (QC) Report.

1.8.2 Reporting

The original and two copies of QC testing records, as well as the records of corrective action taken, shall be furnished the Government Representative daily. Format of report shall be as specified in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.8.3 Remedial Measures

The Quality Control Program Plan shall also outline typical remedial measures to be taken when the acceptance criteria are not met. Remedial measures shall address, but not be limited to: handling/removing obstructions; replacement/repair of elements not completed due to delays; replacement of shear panels that do not meet acceptance criteria.

1.9 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

The Contractor shall measure, handle, transport, and store bulk cement in accordance with the manufacturer's recommendations. Cement shall be stored to prevent damage by moisture. Material which has become caked due to moisture absorption shall not be used. Cement containing lumps or foreign matter of a nature and in amounts that may be deleterious to the injection operations shall not be used. Each instance when the cement source is changed, the DMM batch plant silos shall be completely emptied before storing cement from the new source. Mixing of cement from different sources in the same DMM silos is not permitted.

1.10 JOB CONDITIONS

The Contractor shall familiarize himself with job site geotechnical and hydrological conditions and recognize that amongst others, the silts and clays have variable and often high moisture contents, and variable and often high organic contents. Boring logs are included in the plans and detailed test sheets are available at the Corps of Engineers New Orleans District office. Throughout execution of the Work, the Contractor shall take all precautions and measures necessary to safely move and position deep mixing stabilization equipment, support equipment and personnel around the site. It is anticipated that deep mixing may be performed simultaneously with other activities associated with this contract. Prior to the deep mixing, the Contractor's site preparation work will have produced a suitable working surface for the deep mixing stabilization equipment. The Contractor shall provide equipment, materials, cribbing timber mats or other support structures necessary to provide a stable-working surface for soil/cement stabilization. Granular fill may not be used without prior acceptance of the Government Representative.
The Contractor shall be responsible for evaluating and analyzing the soil and deep mixing stability based on the Contractor's proposed construction sequence and methods if not done as shown in the drawings.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

Cement shall conform to ASTM C 150, low alkali Type II Portland Cement. Type III Portland Cement shall not be used. Slag cement shall conform to ASTM C 1157. All cement shall be homogeneous in composition and properties, and shall be manufactured using the same methods at each plant by each supplier. Tricalcium aluminate content shall not exceed 8 percent.

2.1.2 Water

Water used in drilling, mixing cement grout, and other applications shall be potable.

2.1.3 Admixtures

Cement admixtures will not be allowed, without prior submittal showing effect and acceptance of the Government Representative.

2.1.4 Cement Grout

Cement grout shall be a stable homogeneous mixture of binder, approved admixtures, and water. The mix design indicating the amounts of the various components of the cement grout shall be submitted to the Government Representative for approval. The ratios of various components may be proposed for modification in writing, substantiating reasons for the change, by Contractor, but shall not be implemented until reviewed and accepted by the Government Representative.

2.1.5 Soil-Cement Mixture

Soil-cement mixture shall be a stable uniform mixture of cement and in-situ soil. The Contractor shall propose the ratios and quantities of various components.

2.2 GENERAL EQUIPMENT REQUIREMENTS

All equipment shall be maintained so as to ensure safe, continuous, and efficient production during soil/cement stabilization and other related operations. All equipment shall be dedicated equipment for ground improvement and not retrofitted equipment that was formally dedicated for other purposes. Cement grout distribution will be governed by the penetration/withdrawal rate of the tool, and cement grout pumping rate, both of which shall be controllable separately from the rotational speed. Ground treatment equipment shall be of sufficient size, capacity, and torque to perform the required ground stabilization to the desired depths. The equipment shall utilize sufficient mixing and injecting equipment to adequately blend cement grout with the in-situ soils to produce a distribution of cement grout throughout the mixed in-situ soils sufficient to provide the required minimum strength. The proposed equipment to be used for DMM construction shall be submitted to the Government Representative for review prior to installation of elements.
on-site.

2.2.1 Computerized Controls

All equipment shall have computerized controls and metering equipment to permit accurate and continuous monitoring, recording and control of: mixing tool depth, cement grout flow rates and factors, cement grout injection pressures and quantities, mixing tool rotational speeds, mixing tool down pressure, mixing tool advancement and withdrawal rates, motor amperage or hydraulic pressure, and other operations required to install elements.

2.2.2 Mixing Equipment

Deep mixing equipment to form elements shall use single/multiple shaft mixing equipment of the required diameter. Mixing tools shall uniformly distribute the cement grout across the full mixer diameter and such that the full mixing assembly passes through the element of soil after the cement grout is introduced. Mixing tools shall be rotated sufficiently fast and be oriented to thoroughly break up the in-situ soils and disperse and blend with injected cement grout to form a uniform mixture.

The DMM equipment shall be adequately marked to allow the Government Representative to confirm during construction the penetration depth to within 12 inches.

PART 3 EXECUTION

3.1 ADDITIONAL SUBSURFACE INVESTIGATION

The Contractor shall drill 3-inch continuous undisturbed soil borings along the alignment of the DMM work at roughly uniform spacing to establish general soil and groundwater conditions in the vicinity of the work prior to construction of the deep soil-mixed columns. The investigation shall be done in strict conformance with all current Government practices including but not limited to boring logs and laboratory data reporting. The Contractor's proposed soil boring program shall be approved by the Government Representative prior to commencement. The Contractor shall classify and record soil types within 7 days of obtaining the samples in the field. A water content determination shall be made and recorded on all samples classified as (CH), (CL), and (ML). The Unified Soil classification System (adapted to New Orleans District soils) will be used in classifying the soils. Laboratory tests shall be performed on selected samples by the Contractor. Laboratory tests shall include, but not be limited to, water content determination on all cohesive samples, organic testing and Atterberg limits determination where necessary; unconfined compression on cohesive samples, and gradation on non-cohesive soils. Testing and reporting shall be done in conformance with EM 1110-2-1906. Organic testing shall use ASTM D 2974, Method C. Testing shall be done by a Government validated laboratory. Contractor shall check for utility conflicts at boring locations with appropriate utility agencies, survey boring locations and survey locations tied to the baseline, and provide physical access to boring locations. The Government does not anticipate that any borings will encounter hazardous materials that will require special health and safety measures. If borings encounter hazardous materials or hazardous materials are suspected, the Contractor shall stop drilling work, alert the Government verbally and in writing, document the location in the plans and move to an alternate location.
After completion of the drilling, the boreholes shall be grouted from the bottom of the borehole up to within one foot of the groundline with a grout mix satisfying LADOTD requirements.

3.1.1 Bench Scale Testing

In addition to the laboratory tests required above, the Contractor shall be required to perform a bench scale laboratory test using a minimum of 3 different cement grout mixes. The Contractor shall identify a minimum number of soil types based upon the classification of the twenty 3-inch borings required. For each soil type, 2 samples shall be made for each cement grout combination to permit duplicate breaks at 3, 7, 14, 28, and 56 days. It is possible that more than the twenty 3-inch borings will be required to obtain sufficient samples for the required testing. The Contractor shall furnish the results of bench scale testing.

3.1.2 Validation Test Elements

Once the 28 day break results are obtained from the bench scale testing, the Contractor shall determine the optimum cement grout mix and perform a minimum of 18 test elements from the treatment areas to verify that elements can be constructed with the optimum cement grout mix in the field and determine adequate coring methods to ensure that recovery percentage is at least 80 percent. Each element shall be cored its full length before 28 days after installation according to paragraph "Quality Control". Ten unconfined compressive strength tests shall be conducted on core samples from each test column at depths selected by the Government Representative at approximately 28 days. A hard copy and electronic copy of coring logs and test results shall be submitted to the Government Representative the following day after they are taken. Production columns shall not commence until test columns are shown to meet the acceptance criteria for strength and continuity noted in paragraph "Acceptance Criteria".

3.2 CONSTRUCTION PROCEDURES

Deep mixed element limits and locations shall be established by survey. Individual element locations shall be marked. Sufficient vertical control shall be provided to establish that elements reach plan depths. The Contractor shall construct and maintain stable working surfaces for all DMM operations.

3.3 INSTALLATION OF DMM ELEMENTS

DMM installation shall be performed using the binder factor, water/binder ratio, and other installation conditions (including penetration and withdrawal rate, cement grout flow rate, rotation speed, re-penetration depths) that were applied at the successful validation test element installation and that met the acceptance criteria and were approved by the Government Representative.

The installation of each element shall be continuous without interruption. If an interruption of more than 4 hours occurs that is not due to an obstruction as noted in the paragraph "Injection Deviations", remedial measures shall be implemented to correct the deficient element by the Contractor at no additional cost to the Government, or adverse schedule impact to the project.

The installation of deep mixed elements shall be in the dimensions shown
on the drawings. The Contractor shall provide as-built field measurement
data meeting the requirements of paragraph "SUBMITTALS". All deep mixed
shear panels shall be constructed in such a manner that adjacent columns
provide the minimum overlap and verticality requirements as shown on the
drawings and as specified herein. Columns shall penetrate to at least the
lowest required elevation shown on the drawings. If multi-mixing shaft
rigs are used and the mixing shafts are of different lengths, the shortest
mixing shaft shall penetrate to the lowest required elevation shown on the
drawings.

3.3.1 Deviations

Horizontal deviations from plan locations at the ground surface and
deviations from vertical shall meet requirements of paragraph "Geometric
Tolerances". Each element shall be designated uniquely.

3.3.2 Injection

The Contractor shall assess if a second pass through the element is
necessary for either mixing or cement grout injection, and shall propose
such to the Government Representative for review and acceptance prior to
adopting such procedures. The mixing tool shall mix the cement grout with
the soil to construct the deep mixed elements.

3.3.2.1 Injection Deviations

Unforeseen conditions that result in changes in the rate of rotation or
the rate of cement grout injection or other critical factors during element
installation shall be noted on the installation log and deviations from
the accepted installation parameters corrected as follows:

a. Interruption of the installation process because of obstructions or a
dense layer above the planned tip elevation shall be immediately
brought to the attention of the Government Representative. The mixing
tool shall be removed from the excavation. Obstructions shall be
penetrated with auger drilling equipment or other approved methods to
remove the obstruction(s) or to loosen the obstructions, including any
dense sand layers, sufficiently to allow the installation of the
element unless otherwise indicated by the Government Representative.
Where the obstruction cannot be penetrated, the deep mixed element
shall be completed to the maximum depth penetrated. The need for an
alternate design or remedial construction will then be determined by
the Government Representative. The QC plan shall include procedures
to handle obstructions.

3.3.2.2 Installation Logs/Daily Production Reports

A log of the installation of each element shall be prepared by the
Contractor and submitted to the Government Representative within 48 hours
of installation. The log shall contain the information listed in section
SD-06, Daily Production Reports.

3.4 ACCEPTANCE CRITERIA

A shear panel will be considered acceptable when a tested element in the
shear panel satisfies the criteria below. Elements not satisfying these
criteria shall require remedial measures of the shear panel containing it
as noted in paragraph "Remedial Measures".
(a) Unconfined compressive strength of core samples tested: 15 psi at 28 days. A maximum of 10 percent of the tested core samples can fall below 15 psi at 28 days per tested element. In the event that the unconfined compressive strength falls below 15 psi due to a soil inclusion within the sample not visible prior to testing, the Government Representative may elect, at his discretion, to test an additional core sample obtained in the same 5-foot run. If the second test passes, the first test will not be included in the strength test results.

(b) If tested core samples within 10 feet of the same elevation from three adjacent locations of coring fall below an unconfined compressive strength of 15 psi at 28 days, this will indicate a systematic concern at that elevation, requiring remedial measures as described in paragraph "Remedial Measures". Likewise, if core recovery within 10 feet of the same elevation of three adjacent locations of coring is less than 80 percent, this will also indicate a systematic concern at that elevation, requiring remedial measures as described in paragraph "Remedial Measures".

(c) The elements have been installed to the predetermined design elevation shown on the drawings or to the satisfaction of the Government Representative. The minimum top elevation of the element shall be the design elevation.

(d) The recorded length of the element has been verified as correct by the Government Representative.

(e) The geometric tolerances have been verified in accordance with paragraph QUALITY CONTROL.

(f) No 5-foot segment of core may contain more than 20 percent of its volume comprised of unimproved soil, and any individual or aggregation of lumps of unimproved soil must be no larger than 12 inches for the full diameter of the coring. For making this determination, a single core is deemed representative of the entire cross section of a column. Any material not recovered during coring will be considered unimproved soil.

3.4.1 Work Done Prior to Satisfying Acceptance Criteria is at Contractor's Risk

Any additional construction following DMM installation, such as geogrid placement, or fill placement done prior to receipt of core sample results confirming that the acceptance criteria are met will be done at the Contractor's risk. Any remedial measures required due to not meeting acceptance criteria, shall be done by the Contractor at no additional cost to the Government or delay in schedule. Contractor may propose additional testing for consideration by the government to reduce this risk if he elects to place fill above elements prior to meeting acceptance criteria.

3.4.2 Remedial Measures

Elements not satisfying the acceptance criteria and the shear panel that they are part of shall be replaced at no additional cost to the Government or delay in schedule by the Contractor using methods approved by the Government Representative. Alternatively, the Contractor may elect to core and test the two elements adjacent to the unacceptable element in the shear panel. In the case that the element that does not meet the
acceptance criteria is at the end of the shear panel, the additional core can be done at another location in that element and the adjacent element. If coring and testing shows that the two new core holes meet the acceptance criteria, then the shear panel will be deemed acceptable. If not, remedial measures will be required. Typical remedial measures for elements not meeting the acceptance criteria shall be included in the quality control plan. A detailed plan for remedial measures shall be submitted to the Government Representative for approval for each panel not meeting acceptance criteria.

Depending on the nature and severity of the defect found in the unacceptable shear panel, additional coring of adjacent shear panels installed using similar procedures or materials as the unacceptable panel may be directed by the Government Representative to confirm the quality of those panels. If the additional cores do not meet the acceptance criteria, then additional remedial measures will be required at those shear panels. Any additional coring or remedial measures shall be done at no additional cost to the Government and no delay in schedule.

3.5 COLLECTION AND REUSE OF SOIL/CEMENT RETURN (REM)

3.5.1 Stockpiles

No material shall be stockpiled within 50 feet of existing canal banks, intake bay walls or existing structures without approval of the Government Representative. No material shall be stockpiled on the work platform that DMM operations are done from other than the DMM return material during DMM operations. No more than 1 foot of DMM return material shall be stockpiled above the work platform until the strength requirements noted on the plans have been achieved.

3.5.2 Storm Water Pollution Prevention

The Contractor shall take all necessary precautions and implement measures to prevent any stockpiled material from entering storm drain structures, drainage courses, and other utility lines or from leaving the site via surface runoff, in accordance with the provision of Section 01 57 23.00 12, STORM WATER POLLUTION PREVENTION MEASURES.

3.5.3 Reuse of DMM Return Material

The Contractor may request reuse of the Recycled Embankment Material (REM) in the levee embankments in accordance with the Contract drawings and Section 31 24 00.00 12 EMBANKMENT. Approval for reuse of REM as levee fill will be determined by the Government Representative. Unused REM shall be removed from the site.

3.5.4 Site Restoration

The Contractor shall restore the existing embankment to the design lines and grades throughout the entire length of the project. Site restoration shall be performed in accordance with Section 31 24 00.00 12 EMBANKMENT.

-- End of Section --
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DIVISION 31 - EARTHWORK

SECTION 31 37 00.01 12

RIPRAP

08/08

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1.4  QUALITY CONTROL
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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations in connection with foundation preparation and construction of riprap, as shown on the drawings, and as hereinafter specified.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


1.4  QUALITY CONTROL

1.4.1  General

The Contractor shall inspect all materials before they are incorporated into the work for compliance with contract requirements and any material found to be defective will be rejected. All information pertaining to the inspection shall be recorded and included in quality control reports furnished to the Government Representative. The Contractor shall establish and maintain quality control for construction operations to assure compliance with contract requirements, and maintain records of his quality control for all construction operations. The quality control reports shall include, but not be limited to, the following:

(1) Equipment. Type, size, and suitability for construction of the prescribed work.

(2) Submission of riprap samples for quality testing, if from other than the listed sources, as specified in paragraph "Materials".

(3) Quality of riprap meets the requirements specified.

(4) Quantity of riprap delivered and placed each day.

(5) Gradation of Riprap. Gradation tests of riprap shall be accomplished at the quarry. Tests by weight shall be made by the Contractor in the presence of the Government Representative. The
Contractor shall notify the Government Representative not less than 3 working days in advance of each test. In the event of non-availability of the Government Representative, the Contractor shall perform the tests and certify to the Government Representative that the riprap shipped complies with the specifications. A minimum of one test shall be performed for each 25,000 tons, or fraction thereof, of riprap supplied to the Government from each source. Each test sample shall not be less than 15 tons and shall be representative of the riprap being shipped. Percentage determinations shall be made for each riprap weight specified. Gradation test data shall be recorded on MVN form 602-R "Gradation Test Data Sheet", a copy of which is shown at the end of this section. Failure of the test on the initial sample and on an additional sample will be considered cause for rejection of the quarry and/or quarry process, and all riprap represented by the failed tests shall be set aside and not incorporated into the work. Any additional tests required because of the failure of an initial test sample will not be considered as one of the other required tests. Certification and test results shall represent riprap shipped from the quarry and must be received by the Government Representative before the riprap is used in the work. The Contractor shall designate on the test form that portion (in tons) of the lot tested which is applicable to this contract. Any deviation from the reported tonnage shall be corrected on a revised gradation test form. The Government Representative may direct, under the Section 00700 Standard General Conditions, Article 13, additional testing of riprap furnished to the worksite if the riprap appears, by visual inspection, to be of questionable gradation or quality.

(6) Compliance Surveys. The Contractor shall perform, plot and submit compliance cross section surveys at a maximum of 50 feet intervals. All sections shall be taken at locations corresponding to the Government original survey. They shall be plotted by the Contractor on a minimum scale of 1 inch equals 10 feet horizontally and 1 inch equals 5 feet vertically with the theoretical design cross section and allowable grade tolerances superimposed thereon.

1.4.2 Reporting

The original and two copies of these records, as well as the records of corrective action taken, shall be furnished the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10.

1.5 STANDARD TEST METHOD FOR GRADATION OF STONE

1.5.1 General

1.5.1.1 Sample Selection

The most important part of the test and the least precise is the selection of a representative sample. No "standard" can be devised; larger quarry run stone is best sampled at the shot or muck pile by given direction to the loader; small graded stone is best sampled by random selection from the transporting vehicles. If possible, all parties should take part in the sample selection, and agree before the sample is run, that the sample is representative.

1.5.1.2 Selection of Size for Separation

It is quite possible and accurate to run a gradation using any convenient
sizes for separation, without reference to specifications. After the test is plotted on a curve, then the gradation limits may be plotted. Overlapping gradations with this method are no problem. It is usually more convenient, however, to select points from the gradation limit, such as the minimum 50 percent size, the minimum 15 percent size, and one or two others, as separate points.

1.5.2 Procedure

(1) Select a representative sample (See paragraph "Sample Selection"), weigh and dump on hard stand.

(2) Select specific sizes (see example) on which to run "individual weight larger than" test. Procedure is similar to the standard aggregate gradation test for "individual weight retained".

(3) Determine the largest size stone in the sample. (100 percent size)

(4) Separate by "size larger than" the selected weights, starting with the larger sizes. Use reference stones, with identified weights, for visual comparison in separating the obviously "larger than" stones. Stones that appear close to the specific weight must be individually weighed to determine size grouping. Weigh each size group, either individually or cumulatively.

(5) Subparagraph (4) will result in "individual weight retained" figures. Calculate individual percent retained. Fill-in and document the test.

**EXAMPLE SPECIFIED GRADATION**

<table>
<thead>
<tr>
<th>STONE WEIGHT IN LBS</th>
<th>INDIVIDUAL PERCENT RETAINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 - 125</td>
<td>0 - 10</td>
</tr>
<tr>
<td>25 - 74</td>
<td>40 - 60</td>
</tr>
<tr>
<td>6 - 24</td>
<td>20 - 40</td>
</tr>
<tr>
<td>0 - 6</td>
<td>0 - 15</td>
</tr>
</tbody>
</table>

**EXAMPLE WORKSHEET**

<table>
<thead>
<tr>
<th>STONE WEIGHT IN LBS</th>
<th>INDIVIDUAL WEIGHT IN POUNDS</th>
<th>INDIVIDUAL PERCENT RETAINED</th>
<th>SPECIFIED INDIVIDUAL PERCENT RETAINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 125</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>75 - 125</td>
<td>2,600</td>
<td>8</td>
<td>0 - 10</td>
</tr>
<tr>
<td>25 - 74</td>
<td>16,200</td>
<td>51</td>
<td>40 - 60</td>
</tr>
<tr>
<td>6 - 24</td>
<td>10,000</td>
<td>31</td>
<td>20 - 40</td>
</tr>
<tr>
<td>0 - 6</td>
<td>3,200</td>
<td>10</td>
<td>0 - 15</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>32,000 lbs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Largest stone 125 lbs

PART 2 PRODUCTS

2.1 GEOTEXTILE

Geotextile Fabric: Geotextile Fabric shall comply with Section
2.2 RIPRAP

2.2.1 Description

This work consists of furnishing and placing stone (riprap). The riprap shall be placed at the locations, thicknesses, and lines and grades shown on the drawings or as directed. Riprap class shall be as shown in Table 1. Riprap gradation shall be in accordance with LADOTD LSSRB (Latest Edition).

2.2.1.1 Materials

Riprap shall be from a Government or LADOTD approved source. All riprap (stone) shall be of a hard, durable quality such as will not disintegrate under the elements or be easily broken in handling. It shall be clean and free from earth, dust, or other refuse. The faces of individual pieces of stone shall be roughly angular, not rounded, in shape. Field stone will not be accepted. If the Contractor proposes to furnish stone from a source not approved by the Government or LADOTD, the Government will make such investigations as necessary to determine whether acceptable stone can be produced from the proposed source. Satisfactory service records on work outside the Corps of Engineers will be acceptable. If no such records are available, the Government will make tests to assure the acceptability of the stone. The tests to which the stone may be subjected will include petrographic analysis, specific gravity, abrasion, unit weight, absorption, wetting and drying, freezing and thawing and such other tests as may be considered necessary by the Government Representative. The following guidance is provided for use by the Contractor in analyzing a source of stone not approved by the Government. Stone that weighs less than 155 pounds per cubic foot, SSD or has more than 2 percent absorption will not be accepted unless other tests and service records show that the stone is satisfactory. Saturated surface dry (SSD) density and absorption shall be determined in accordance with ASTM C127. Samples of stone shall be submitted to the Government Representative for testing and acceptance prior to delivery of any stone to the site of the work. Samples shall consist of at least seven pieces of stone, roughly cubical in shape and weighing not less than 100 pounds each. All such samples shall be taken by the Contractor under the supervision of the Government Representative. The samples shall be shipped at the Contractor's expense to the Government approved testing laboratory at least 90 days in advance of the time of the placing of the stone is expected to begin. The tests will be conducted in accordance with applicable ASTM methods. The cost of testing will be borne by the Government.

Riprap: Riprap shall be reasonably well graded and shall comply with the gradation requirements specified in LADOTD Standard Specifications for Roads and Bridges, Section 711.02 (Latest Edition).

Table 1
Riprap Class*

<table>
<thead>
<tr>
<th>Riprap Class*</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 LB</td>
</tr>
<tr>
<td>55 LB</td>
</tr>
<tr>
<td>130 LB</td>
</tr>
<tr>
<td>250 LB</td>
</tr>
</tbody>
</table>
Table 1

*The stone size used to define the Riprap Class is the minimum median stone size for the stone class. The minimum thickness of a riprap layer shall be no less than the spherical diameter of the maximum stone size in the Riprap Class.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS FOR RIPRAP AND GEOTEXTILE

(a) Geotextile Fabric: Geotextile fabric shall be placed on the prepared surface area or slope in accordance with Section 31 05 19.04 12 SEPARATOR GEOTEXTILE before placement of riprap. Care shall be taken not to damage the geotextile fabric when placing riprap. Placing riprap by rolling riprap down slope, or dropping riprap from extreme heights, or by similar methods likely to damage geotextile fabric, will not be permitted. Damaged geotextile fabric shall be repaired or replaced as directed by the Government Representative.

(b) Riprap: Areas on which riprap is to be placed shall be graded to the required section. Riprap class shall be as shown in Table 1 and at locations as shown on plans. The riprap shall be placed at the locations, thicknesses, and lines and grades shown on the drawings or as directed. The riprap shall have a minimum thickness of 1 foot - 6 inches. It shall be placed on the prepared slope or area in a manner which will produce a reasonably well-graded mass of stone with a minimum practicable percentage of voids. The entire mass of stone shall be placed in one operation to conform to the lines, grades, and thickness to avoid displacing underlying material. Placing of riprap in layers, or dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

-- End of Section --
PART 1    GENERAL

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1.4 SUBMITTALS
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PART 3    EXECUTION

3.1 CONSTRUCTION REQUIREMENTS FOR RIPRAP AND GEOTEXTILE
3.2 PLACEMENT REQUIREMENTS FOR GROUT

-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations in connection with foundation preparation and construction of grouted riprap, as shown on the drawings, and as hereinafter specified.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM C231 (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method


ASTM C618 (2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C937 (2010) Grout Fluidifier for Preplaced-Aggregate Concrete
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Grout Mixture Proportions; G

Grout mixture proportions shall be determined by the Contractor and submitted for approval. The grout mixture quantities of all ingredients per cubic yard that will be used in the manufacture of the grout shall be stated. Proportions shall indicate the mass of cement, pozzolan, and water; the mass of aggregate in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C1077, which show that proportions thus selected will produce grout of the qualities specified. Test reports shall be from tests performed on grout produced from the submitted mixture proportions. Compressive strength of grout shall be determined in accordance with ASTM C942. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and grout are satisfactory.

Cementitious Materials; G

Cementitious materials will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports, stating that materials meet the requirements of the
specification under which they are furnished. Certification and mill test reports shall be from samples taken from current production and be representative of the particular lot furnished.

Aggregate; G

Information identifying the aggregate source to be used along with gradation tests for fine aggregates shall be submitted for approval. Specific gravity and absorption of fine aggregates as determined by ASTM C128 shall also be submitted.

Admixtures; G

All admixtures shall be certified for compliance with the specification requirements or manufacturer's literature which demonstrates compliance with these specifications shall be submitted.

1.5 QUALITY CONTROL

1.5.1 General

The Contractor shall inspect all materials before they are incorporated into the work for compliance with contract requirements and any material found to be defective will be rejected. All information pertaining to the inspection shall be recorded and included in quality control reports furnished the Government Representative. The Contractor shall establish and maintain quality control for construction operations to assure compliance with contract requirements, and maintain records of his quality control for all construction operations. The quality control reports shall include, but not be limited to, the following:

(1) Equipment. Type, size, and suitability for construction of the prescribed work.

(2) Quality of riprap meets the requirements specified in Section 31 37 00.01 12 RIPRAP.

(3) Quantity of riprap delivered and placed each day.

(4) Compliance Surveys. Upon completion of suitable reaches of berm erosion protection, the Contractor shall perform, plot and submit compliance cross section surveys at a maximum of 50 feet intervals, berm transitions and breakpoints. All sections shall be taken at locations corresponding to the Government original survey. They shall be plotted by the Contractor on a minimum scale of 1 inch equals 10 feet horizontally and 1 inch equals 5 feet vertically with the theoretical design cross section and allowable grade tolerances superimposed thereon.

(5) Grout. Grout will be sampled in accordance with ASTM C172. Grout flow and air content will be determined in accordance with ASTM C939 and ASTM C231, respectively, when cubes are molded. Compression test specimens will be made, cured, and transported in accordance with ASTM C942. Compression test specimens will be tested in accordance with ASTM C942. Samples for strength tests will be taken not less than once each shift in which grout is produced. A minimum of 3 specimens will be made from each sample; 1 will be tested at 7 days for information and 2 will be tested at 28 days for acceptance.
1.5.2 Reporting

The original and two (2) copies of these records, as well as the records of corrective action taken, shall be furnished the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL.

PART 2 PRODUCTS

2.1 GEOTEXTILE

Geotextile Fabric: Geotextile Fabric shall comply with Section 31 05 19.04 12 SEPARATOR GEOTEXTILE.

2.2 RIPRAP

2.2.1 Description

This work consists of furnishing and placing stone (riprap) which will be grouted. The riprap shall be placed at the locations, thicknesses, and lines and grades shown on the drawings or as directed.

2.2.2 Materials

Riprap shall be Class 130 lb and 250 lb as shown on plans and as specified in Section 31 37 00.01 12 RIPRAP.

2.3 GROUT MATERIALS

2.3.1 Description

This work consists of furnishing, placing, and consolidating grout for placement on Riprap - grouted in accordance with these specifications, plan details and as directed.

2.3.2 Materials

Grout shall be composed of water, cementitious materials, air-entraining admixtures, water reducers, fluidifiers, and fine aggregate. A retarder may be used.

2.3.2.1 Portland Cement

Portland cement used in grout shall conform to the requirements of ASTM C 150, Type I or II, low alkali, except that the maximum amount of C3A in Type I cement shall be 10 percent and cement with a Blaine Fineness of 400 square meters per kilogram or greater shall be considered Type III cement.

2.3.2.2 Pozzolan

Pozzolan shall be fly ash conforming to ASTM C618.

2.3.2.3 Fine Aggregate

The quality of fine aggregate shall conform to ASTM C33, except only natural sands shall be used. Fine aggregate shall conform to the grading requirements of LSSRB 1003.02 for concrete or mortar sand or ASTM C33.
2.3.2.4 Water

The water used in the grout shall be fresh, clean, potable, and free from injurious amounts of oil, acid, alkali, salts, sugar, or organic matter, except that nonpotable water may be used if it meets the requirements of COE CRD-C 400.

2.3.2.5 Grout Fluidifier

Grout fluidifier shall conform to ASTM C937.

2.3.2.6 Water-reducing or Retarding Admixtures

Water-Reducing or Retarding Admixtures shall conform to ASTM C494/C494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

2.3.2.7 Air-entraining Admixture

The air-entraining admixture shall conform to ASTM C260 and shall consistently cause the grout to have an air content in the specified range under field conditions.

2.4 GROUT DESIGN REQUIREMENTS

The grout mixture proportions shall be determined by the Contractor and submitted for approval. Grout shall be composed of water, cementitious materials, air entraining admixture, water reducers, fluidifiers, and fine aggregate. A retarder may be used.

2.4.1 Specified Compressive Strength

The specified compressive strength shall be 1,700 psi at 28 days.

2.4.2 Maximum Water to Cementitious Materials Ratio

The maximum water to cementitious materials ratio (W/CM) shall be 0.50.

2.4.3 Air Content

Air content of the grout mixture as determined by ASTM C231 within 15 minutes after mixing shall be 9.0 plus or minus 1 percent.

2.4.4 Grout flow

Grout flow shall be 18.0 plus or minus 2.0 seconds when sampled from the agitator and tested in accordance with ASTM C939.

2.4.5 Pozzolan Content

If pozzolan is used, the minimum pozzolan content shall be 15 percent by weight of the total cementitious materials.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS FOR RIPRAP AND GEOTEXTILE

(a) Geotextile Fabric: Geotextile fabric shall be placed on the
prepared surface area or slope in accordance with Section 31 05 19.04 12 SEPARATOR GEOTEXTILE before placement of riprap. Care shall be taken not to damage the geotextile fabric when placing riprap. Placing riprap by rolling riprap down slope, or dropping riprap from extreme heights, or by similar methods likely to damage geotextile fabric, will not be permitted. Damaged geotextile fabric shall be repaired or replaced as directed by the Government Representative.

(b) Riprap: Areas on which riprap is to be placed shall be graded to the required section. Riprap shall be Riprap Class 130 lb and 250 lb. The riprap shall be placed at the locations, thicknesses, and lines and grades shown on the drawings or as directed. It shall be placed on the prepared slope or area in a manner which will produce a reasonably well-graded mass of stone with a minimum practicable percentage of voids. The entire mass of stone shall be placed in one operation to conform to the lines, grades, and thickness to avoid displacing underlying material. Placing of riprap in layers, or dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

3.2 PLACEMENT REQUIREMENTS FOR GROUT

Before placement, temporary end-dams or soil berms shall be placed as directed by the Government Representative to confine the grout. Grout shall be placed continuously after the riprap protection has been installed to the design grade. Grout shall be placed to the lines and grades shown on the plans and as directed. Grout shall be consolidated by internal vibrating equipment and shall fill the voids. Grout will not require sampling and testing other than the approved mix design unless otherwise directed by the Government Representative.

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STEEL SHEET PILING

11/01

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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor and materials and performing all operations in connection with the installation of Contractor furnished steel sheet piling in accordance with these specifications and applicable drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

1.3 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.4 QUANTITIES

The estimated quantities of sheet piling listed in the bid schedule of the contract as to be furnished by the Contractor are given for bidding purposes only. Sheet piling quantities for payment shall consist of the square feet of piling acceptably installed. This quantity shall consist of the lengths of piles driven below the elevations indicated for the top of piles times the length along the wall alignment as shown on the drawings plus any additions thereto resulting from changes in design or alignment as provided in paragraph "Driving."

1.5 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


1.6 QUALITY ASSURANCE

Requirements for material tests, workmanship and other measures for quality assurance shall be as specified herein and in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

1.6.1 Materials Tests

Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Shop drawings for sheet piling, including fabricated sections, shall be submitted for approval and shall show complete piling dimensions and details, driving sequence and location of installed piling. Shop drawings shall include details and dimensions of templates and other temporary guide structures for installing piling, and shall provide details of the method of handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

Substitute Sheet Piling Submittals

The Contractor shall submit shop drawings for substitute sheet piling.

SD-03 Product Data

Equipment Descriptions; G

Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval prior to commencement of work.
SD-06 Test Reports

Driving Records

Records of the sheet piling driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling.

SD-07 Certificates

Materials Test Certificates

Materials test certificates shall be submitted for each shipment and identified with specific lots prior to installing piling. Identification data should include piling type, dimensions, section properties, heat analysis number, chemical composition, mechanical properties and mill identification mark.

1.8 QUALITY CONTROL

1.8.1 General

The Contractor shall establish and maintain quality control for pile driving records and operations to assure compliance with contract specifications and maintain records of his quality control for all construction operations including, but not limited to, the following:

(1) Accurate location, alignment and plumbness of piling.
(2) Full and proper engagement of interlocks.
(3) Equipment Descriptions of sheet piling equipment to be used.
(4) Driving (pile hammer and rate of operation).
(5) Final position; depth of penetration; tip and cut-off elevations.
(6) Uplift and vertical tolerances after driving.
(7) Location and elevation of any obstruction encountered and action directed by the Government Representative.
(8) Pulled piles and redriving.
(9) Length of cover plate and weld size.
(10) Manufacture and driving of fabricated sections.
(11) Cutting and splicing (welding).
(12) Stockpiling and storage.
(13) Removal and disposal of damaged piles.
1.8.2 Reporting

The original and two copies of these records and tests, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.9 DELIVERY, STORAGE AND HANDLING

Materials delivered to the site shall be new and undamaged and shall be accompanied by materials test certificates. The manufacturer's logo and mill identification mark shall be provided on the sheet piling as required by the referenced specifications. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate required inspection activities.

PART 2 PRODUCTS

2.1 STEEL SHEET PILING

Steel for sheet piling shall conform to the requirements of ASTM A572, Grade 50. Sheet piling, including special fabricated sections, shall be of the type and dimensions indicated on the drawings and shop drawings, and be of a design such that when in place they will be continuously interlocked throughout their entire length. All sheet piling shall be provided with standard pulling holes located approximately 4 inches below the top of the pile, unless otherwise shown or directed. Steel sheet piling shall be hot rolled and shall have the properties equivalent to those listed in the following table:

<table>
<thead>
<tr>
<th>Type of Section</th>
<th>Thickness (inches)</th>
<th>Section Modulus of Wall in³/ft</th>
<th>Section Moment of Inertia in⁴/ft</th>
<th>Nominal Depth (inches)</th>
<th>Nominal Interlock Strength (lbs/lin in.)</th>
<th>Theoretical Driving Width (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PZ 22</td>
<td>0.375</td>
<td>18.1</td>
<td>84.4</td>
<td>9</td>
<td>N/A</td>
<td>22</td>
</tr>
<tr>
<td>PZ 27</td>
<td>0.375</td>
<td>30.2</td>
<td>184.4</td>
<td>12</td>
<td>N/A</td>
<td>18</td>
</tr>
</tbody>
</table>

2.1.1 Substitute Sheet Piling Submittals

When proposing substitute piling, the Contractor shall submit, for approval, the following items at no additional cost to the Government:

1. Complete shop drawings of the proposed sections showing the dimensions and details of the alternate piling including all fabricated and corner sections.
2. A complete layout of the alternate sheet piling. The P.I. Stations transitions shall remain unchanged.

2.2 SHEET PILING LENGTHS

All new sheet piling shall be provided in full lengths.
2.3 CORNERS

2.3.1 Rolled Corners

Rolled corners, formed with new sheet piling, shall be of the types and dimensions shown on the drawings. Any proposed variations from the details shown on the drawings shall be submitted for approval of the Government Representative. The sheet pile types shall be as required for the corners being manufactured and shall conform to the requirements of ASTM A572, Grade 50 and all other requirements stated above for new piling.

2.3.2 Pilepro

Pilepro connectors or approved equal may be used in lieu of or in combination with rolled corners or formatted sections.

2.4 FABRICATED SECTIONS

Fabricated sections, including special corners and transition piles shall conform to the requirements stated herein, the details shown on the drawings and the piling manufacturer's recommendations for fabricated sections. Metalwork fabrication for sheet piling sections shall conform to the requirements of Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. Steel plates and angles used to fabricate the special sections shall conform to the same material specification and grade as the sheet pile. Unless noted otherwise, all fabricated connections shall be made with 7/8 inch diameter bolts, meeting the requirements of ASTM A325, Type 3, or ASTM A490, Type 3. Nuts shall meet the requirements of ASTM A563, Grade C3 or DH3. Washers shall meet the requirements of ASTM F436, and shall be manufactured from weathering steel meeting the requirements of ASTM A588 or ASTM A709. Bolts shall be spaced 6 inches on centers for the length of the section except for 2 feet at each and where they shall be spaced 3 inches on centers. Welding of the longitudinal joint will not be allowed. Shop drawings and details for the fabricated connection shall be submitted for approval.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Placing and Driving

3.1.1.1 Placing

Any excavation required within the area where sheet pilings are to be installed shall be completed prior to placing sheet pilings. Pilings shall be carefully located as shown on the drawings or directed by the Government Representative. Pilings shall be placed as true to line as possible. Suitable temporary wales, templates, or guide structures shall be provided to insure that the piles are placed and driven to the correct alignment. Piles shall be placed in a plumb position with each pile interlocked with adjoining piles for its entire length, so as to form a continuous diaphragm throughout the length of each run of piling wall. Interlocks shall be properly engaged. The Contractor's personnel shall not sit or place themselves on top of the sheet piling during the handling, installation, and removal of the piling.
3.1.1.2 Driving

All piles shall be driven to the depths shown on the drawings and shall extend to the cut-off elevation indicated. A tolerance of 1 1/2 inches above or below the indicated cut-off elevation will be permitted. Pilings shall be driven by approved methods so as not to subject the pilings to damage and to insure proper interlocking throughout their lengths. Pile hammers shall be maintained in proper alignment during driving operations by use of leads or guides attached to the hammer. A protecting cap shall be employed in driving, when required, to prevent damage to the tops of pilings. Pilings damaged during driving or driven out of interlock shall be removed and replaced. All piles shall be driven without the aid of a water jet, unless otherwise authorized. Adequate precautions shall be taken to insure that piles are driven plumb. Sheet piling shall not be driven more than 1/8 inch per foot out of plumb in the plane of the wall nor more than 1/8 inch per foot out of plumb perpendicular to the plane of the wall. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb more than 1/8 inch per foot in the plane of the wall or 1/8 inch per foot perpendicular to the plane of the wall, the assembled piling shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling shall be 1 1/4 inch per foot of length. Unless specifically indicated otherwise, each run of piling wall shall be driven to grade progressively from the start and pilings in each run shall be driven alternately in increments of depth to the required depth or elevation. On each day of sheetpile driving, the Contractor shall stab only the number of piles that can be driven to grade by the end of the day, and all piling stabbed shall be driven to grade by the end of each working day except that the last two piles may remain tapered up to receive the next days piles. No pile shall be driven to a lower elevation than those behind it in the same run except when the piles behind it cannot be driven deeper or in areas where there will be wall penetrations or obstructions are encountered. In this case, piling will be allowed to remain above final grade until the obstruction is removed or the penetration is completed. Alternately, if it is determined that an obstruction cannot be removed, the Contractor shall make such changes in design alignment of the pile structure as may be deemed necessary by the Government Representative to insure the adequacy and stability of the structure. Payment for the additional labor and materials necessitated by such changes will be made at the applicable contract prices. If the piling next to the one being driven tends to follow below final grade, it may be pinned to the next adjacent piling. Piles shall not be driven nor pulled within 100 feet of concrete less than 7 days old nor within 30 feet of concrete less than 28 days old.

3.1.2 Emergency Locking System on Pile Driving Head

All pile driving equipment shall be equipped so as to prevent piles from falling when a single or multiple power failure occurs after the pile driving head is attached to the pile. The jaws of vibratory hammers shall be equipped with devices such that upon loss of hydraulic pressure, the jaws will not release the pile.

3.1.3 Cutting Off and Splicing

Piles extending above grade in excess of the specified tolerance, and which cannot be driven deeper, shall be cut off to the required grade.
The Contractor shall also trim the tops of piles excessively battered during driving, when directed to do so, at no cost to the Government. Cut-offs shall become the property of the Contractor and shall be removed from the worksite. Piles driven below the elevations indicated for the top of piles and piles which, because of damaged heads, have been cut off to permit further driving and are then too short to reach the required top elevation, shall be extended to the required top elevation by welding an additional length, when directed, without cost to the Government. Should splicing of additional lengths be necessary, the splice shall consist of an approved butt joint with a weld that fully penetrates the web. Welded extensions shall be a minimum of 6 inches in length. Piles adjoining spliced piles shall be full length unless otherwise approved. When piles are to be driven in sections and spliced together, they shall be delivered on site in full lengths and cut for splicing only after delivery. Only those portions of the originally uncut pile shall be spliced together to form the final in-place full-length pile. Splices for these piles shall conform to the details shown on the drawings. Welding of splices shall conform to the requirements of Section 05 50 03 00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. Ends of pilings to be spliced together shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. The Contractor may cut holes in the piles for bolts, rods, drains or utilities at locations and of sizes shown on the drawings or as directed. All cutting shall be done in a neat and workmanlike manner. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods, which will not damage the remaining metal. Holes, other than bolt holes, shall be reasonably smooth and of the proper size for rods and other items to be inserted.

3.1.4 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be damaged or driven out of interlock shall be removed and replaced.

3.1.5 Pulling and Redriving

The Contractor may be required to pull selected piles after driving, for test and inspection, to determine the condition of the piles. Any pile so pulled and found to be damaged to the extent that its usefulness in the structure is impaired shall be removed from the work and the Contractor shall furnish and drive a new pile to replace the damaged pile. Piles pulled and found to be in satisfactory condition shall be redriven.

3.1.6 Void Backfill

Where voids adjacent to the steel sheet piling are induced by pile driving or pulling operations, the Contractor shall pump out all seepage and rain water and backfill with a tremie-placed slurry. The slurry shall consist of one part cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids.

3.1.7 Painting

Paint entire pile length as per Section 09 97 02.01 12 PAINTING: COAL TAR
EPOXY SYSTEM.

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PRESTRESSED CONCRETE PILES

06/2010

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor, and materials, except materials specified to be furnished by the Government, and performing all operations in connection with the manufacture, and installation of prestressed concrete piles.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)


ASTM INTERNATIONAL (ASTM)

ASTM A82 (2005a) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement


ASTM A615 (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement


1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Cutting of Piles; G

The proposed method for cutting piles for desired length and for removal of driving heads shall be submitted for approval 30 days prior to the start of pile driving.

Delivery, Storage, and Handling; G

Delivery, storage, and handling plans for piles shall be
submitted for approval at least 30 days prior to delivery of piles to the jobsite.

Prestressed Concrete Piles; G

Detailed drawings of piles shall be submitted for approval at least 30 days prior to commencement of work. Drawings shall show pile dimensions and fabrication details, including forms, reinforcement, collars, shoes, splices, build-ups, embedded or attached lifting devices, pick-up and support points.

Pile Placement and Tolerances; G

Pile placement plans, as specified in paragraph "Pile Placement and Tolerances," shall be submitted for approval at least 30 days prior to delivery of piles to the jobsite.

Voids; G

Statements of materials and methods for forming voids shall be submitted for approval.

SD-03 Product Data

Pile Driving Equipment; G

Descriptions of pile driving equipment, including leads, extractors, jetting equipment, and preboring equipment, shall be submitted for approval at least 30 days prior to commencement of work. The following information for each hammer proposed shall be submitted for each proposed hammer:

(1) make and model
(2) ram weight (pounds)
(3) anvil weight (pounds)
(4) weight of the moving parts of the hammer (pounds)
(5) rated stroke (inches)
(6) rated energy range (foot-pounds)
(7) rated speed (blows per minute)
(8) steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
(9) power pack description
(10) pile driving helmet, make, and weight (pounds)
(11) pile cushion material, type, proposed thickness, modulus of elasticity, and coefficient of restitution
(12) the make-up of the proposed cap block, including material type, dimensions, modulus of elasticity, and coefficient of restitution
(13) rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch)

SD-05 Design Data

Concrete Mix; G

Concrete mixture proportions shall be submitted prior to casting piles.

Curing of Piles; G

Methods and details for curing piles shall be submitted for approval prior to casting piles.

SD-07 Certificates

Certificates of Compliance

Certificates of compliance for admixtures, aggregates, cement, pozzolan, reinforcing steel, and prestressing steel shall be submitted prior to commencing fabrication of piles. Certificates for admixtures, aggregates, cement, and pozzolan shall indicate conformance with the requirements of the specifications and shall be submitted along with concrete mix proportions. Manufacturer's literature indicating conformance may be submitted for admixtures. Aggregate source and gradation information shall be submitted for aggregates. If a blended product meeting ASTM C595 is to be used, the manufacturer shall also certify in writing that the amount of pozzolan or slag in the finished cement will not vary more than plus or minus 5.0 mass percent of the finished cement from lot to lot or within a lot.

Driving Record Forms; G

The proposed form for recording pile driving records shall be submitted for approval 30 days prior to commencement of work. Requirements are specified in paragraph "Driving Records."

Driving Records

Original pile driving records shall be submitted daily.

1.5 QUALIFICATIONS

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, or the manufacturer shall establish a quality control program based on PCI MNL-116, prior to the start of production.

1.6 DELIVERY, STORAGE, AND HANDLING

Piles shall be stored, handled, and transported in accordance with PCI MNL-116 except as follows. Methods used for handling and storage of piles shall be such that the piles are not subjected to excessive bending stress, cracking, spalling, or other damage. Piles which are damaged during delivery, storage, or handling to the extent they are rendered
unsuitable for the work, in the opinion of the Government Representative, will be rejected and shall be removed from the work site at no cost to the Government.

1.6.1 Delivery and Storage

Piles shall be held at the plant until the specified ultimate compressive strength is obtained or 14 days, whichever is greater. Storage areas for piles shall be stabilized and suitable foundations provided so differential settlement or twisting of the pile does not occur. Stacked piles shall be separated and supported by uniform load transferring material placed across the full width of each bearing point and in vertical planes between the piles. The stacks shall be limited to 5 feet in height unless otherwise approved. Each pile shall be stacked in a straight position and supported every 10 feet or less along its length (ends inclusive) to prevent excessive sweep in the pile.

1.6.2 Handling

Piles shall be lifted by means of a suitable bridle or slings attached to the pile at the marked pickup points. Unless special lifting devices are attached for pickup, pickup points shall be plainly marked on all piles after removal of the forms. Alternate pickup methods or locations shall be subject to approval prior to commencement of pile fabrication. Dragging of piles across the ground will not be permitted. The Contractor shall inspect each pile for sweep and structural damage such as cracking and spalling before transporting them from the storage site to the driving area. Sweep shall be checked by placing the pile on a firm level surface and rotating the pile. Sweep shall be limited to 2 inches over the length of the pile. The Contractor shall again check the pile for excessive sweep and damage immediately prior to placement in the driving leads. Piles having excessive sweep shall not be used.

1.7 QUALITY CONTROL

1.7.1 General

The Contractor shall establish and maintain quality control for pile manufacturing and driving operations, assure compliance with contract specifications and maintain quality control records for all construction operations including, but not limited to, the following:

(1) Testing and gradation of aggregates and compressive strength of concrete as required, including batched proportions.

(2) Setting and bracing of forms and checkout just prior to concrete placement, including accurate placement of reinforcing steel.

(3) Casting, handling and storage of precast, prestressed piling: records of prestressing tension strands.

(4) Curing method and duration.

(5) Driving of all piles and maintaining records of such.

1.7.2 Reporting

The original and two copies of these records and reports, as well as corrective action taken, shall be furnished the Government daily.
of the report shall be as prescribed in the Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2   PRODUCTS

2.1   MATERIALS

2.1.1   Admixtures

Chemical admixtures shall conform to ASTM C494. Air-entraining admixture shall conform to ASTM C260. Calcium chloride or admixtures containing chlorides or nitrates shall not be used.

2.1.2   Aggregates

Aggregates shall conform to ASTM C33, except as specified otherwise herein. Coarse aggregate shall meet the additional requirements for Class 3M. Aggregates shall conform to the grading requirements of either ASTM C33 and LSSRB 1003.02. Fine aggregates from different sources of supply shall not be mixed or stored in the same stockpile, or used alternately in the same concrete mix or the same structure without approval. The fineness modulus of fine aggregate shall not be less than 2.40 or greater than 3.00. For piles that will be exposed to freezing and thawing, fine and coarse aggregate subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88 shall show a loss not greater than 10 percent. If the selected aggregates fail the soundness test, the aggregate source may be used if the concrete specimens made with the aggregates have a durability factor of not less than 80, based on 300 cycles of freezing and thawing, when tested in accordance with ASTM C666.

2.1.3   Cement

Portland cement shall conform to ASTM C150, low alkali, Type I, II or III with a maximum of 15 percent tricalcium aluminate. Blended hydraulic cement shall conform to ASTM C595, Type IP.

2.1.4   Pozzolan

Pozzolan shall conform to ASTM C618, Class C or F, with the Multiple Factor and the Effectiveness in Controlling Alkali-Silica Reaction requirements of Table 3.

2.1.5   Prestressing Steel

Prestressing steel shall be seven-wire, 1/2 inch diameter, Grade 270, low relaxation steel strands conforming to the requirements of ASTM A416. Steel shall be free from grease, oil, wax, paint, soil, dirt, loose rust, kinks, bends, and other defects.

2.1.6   Reinforcing Steel

Non-prestressing reinforcing steel shall conform to ASTM A615 Grade 60, deformed.

2.1.7   Tires and Spirals

Steel for ties and spirals shall conform to ASTM A82
2.1.8 Water

Water for mixing concrete shall be fresh, clean, drinkable, and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials, or other substances that may be deleterious to concrete or steel. Undrinkable water may be used if it meets the requirements of COE CRD-C 400. The time of set for concrete made with undrinkable water may vary from one hour earlier to one and one-half hours later than a control sample made with distilled water.

2.2 FABRICATION

2.2.1 Prestressed Concrete Piles

Prestressed concrete piles shall be solid concrete piles of the type indicated. Piles shall be cast as monolithic units of homogeneous concrete and pretensioned with prestressing steel. Manufacturing requirements for piles shall conform to PCI MNL-116 except as modified herein. Embedded or attached lifting devices for pick-up shall be as shown on the drawings. Detail drawings of piles, showing dimensions and fabrication details including forms, reinforcement, collars, shoes, and embedded or attached lifting devices, pick-up points shall be submitted for approval. The Contractor shall notify the Government Representative one (1) week prior to the date casting of piles is to begin.

2.2.2 Forms

Forms shall be of steel, braced and stiffened against deformation, accurately constructed, watertight, and supported on unyielding concrete casting beds. Form surfaces shall be within 1/4 inch of a true plane in a length of 50 feet. Forms shall permit movement of the pile without damage during release of the prestressing force. Voids shall be formed.

2.2.3 Reinforcements and Embedments

Reinforcing steel, prestressing steel, and embedded items shall be accurately positioned in the forms and secured to prevent movement during concrete placement. Steel shall have a minimum concrete cover of 2-1/2 inches. Reinforcing steel details shall conform to ACI SP-66. Welding of reinforcing steel shall be in accordance with AWS D1.4/D1.4M.

2.2.4 Concrete Mix

The concrete mix shall be selected by the Contractor to have a compressive strength of 5000 psi at 28 days (90 days if pozzolan is used) and a slump of 3 inches. If a higher slump is required, it shall be attained through the use of a chemical admixture for use in producing flowing concrete in accordance with ASTM C1017, and the slump of the concrete shall not exceed 8 inches after the addition of the admixture and shall be in the range of 1 to 4 inches prior to adding the admixture. The water-cementitious materials ratio (by weight) shall be held to the minimum consistent with workability required for placement but in no case shall it exceed 0.45. Nominal maximum size coarse aggregate shall be 1 inch. If pozzolan is used, it shall range from 15 to 30 percent by weight of the total cementitious materials. Once production begins, changes to the mix will not be permitted without written submittal and approval of the proposed changes.
2.2.5 Concrete Work

Concrete shall not be deposited in the forms until the placement of the reinforcement and anchorages has been inspected and approved by the Government Representative. Conveying equipment shall be cleaned thoroughly before each run and the concrete conveyed from the mixer to the forms as rapidly as practicable using methods that will not cause segregation or loss of ingredients. Concrete shall be deposited as nearly as practicable in its final position in the forms. At any point in conveying, the free vertical drop of the concrete shall not exceed 3 feet. Chuting will be permitted if the concrete is deposited into a hopper before being placed in the forms. Concrete that has segregated in conveying shall be removed. Each pile shall be produced of dense concrete with smooth surfaces. Each pile shall be a continuous pour until it is completed. Vibrator heads shall be smaller than the minimum distance between steel pretensioning. Side forms shall not be removed until concrete has attained 3500 psi compressive strength. Dimensional tolerances shall conform to PCI MNL-116. The ends of all piles and corners of square piles shall be chamfered 3/4 inch or, in lieu of chamfering, may be rounded to a 1-inch radius.

2.2.6 Pretensioning

Anchorages for tensioning the prestressing steel shall be an approved type. The tension to which the steel is to be pretensioned shall be measured by the elongation of the steel and also by the jack pressure reading on a gauge or by the use of an accurately calibrated dynamometer. The gauge or dynamometer shall have been calibrated by a calibration laboratory approved by the Government Representative within 12 months of commencing work and every 6 months thereafter during the term of the contract. Means shall be provided for measuring the elongation of the steel to the nearest 1/4 inch. The applied load determined from elongation measurements shall be computed using load-elongation curves for the steel used. When the difference between the results of measurement and gauge reading is more than 5 percent, the cause of the discrepancy shall be corrected. The tensioning steel shall be given a uniform prestress prior to being brought to design prestress. The same initial prestress shall be induced in each unit when several units of prestressing steel in a pile are stretched simultaneously.

2.2.7 Detensioning

Releasing of prestressing force in pretensioned piles shall be performed in a manner that minimizes eccentricity of prestress. Tension in the strands shall be released from the anchorage gradually. In no case shall the stress be released after casting without approval by the Government Representative. The transfer of prestressing force shall be done when the concrete has reached a compressive strength of not less than 3500 psi. The prestressing steel shall be cut or ground flush with the pile ends.

2.2.8 Curing of Piles

Piles shall be cured in accordance with the provisions contained in PCI MNL-116 except as follows. The maximum rate of heat gain shall not exceed 40 degrees Fahrenheit per hour and the maximum concrete temperature shall not exceed 165 degrees Fahrenheit during the curing cycle. Curing shall be continued until the concrete has attained a compressive strength of at least 3500 psi as determined by the concrete test cylinders.
2.2.9 Splices

Splices will not be permitted.

2.2.10 Build-Ups

Build-ups shall be in accordance with the procedures for build-up without driving as detailed in PCI STD-112 and shall be constructed subsequent to final seating of the pile. The joint between the pile and the build-up shall be protected by an approved mortar or epoxy. Build-ups shall be protected from standing water during the curing period. Concrete in the build-up shall have a minimum compressive strength of 5000 psi.

2.3 TEST, INSPECTIONS, AND VERIFICATIONS

Testing during manufacture shall be performed by an approved commercial testing laboratory or by an approved laboratory maintained by the manufacturer of the material. Minimum requirements for testing during manufacture shall be as required in PCI MNL-116 except as modified herein.

2.3.1 Concrete Cylinders

A minimum of four standard 6-inch by 12-inch concrete test cylinders per casting bed shall be made to indicate transfer and 28-day (90-days if pozzolan is used) strengths. The test cylinders may be 4-inch by 8-inch in lieu of the standard 6-inch by 12-inch cylinders when the required 28-day (90-days if pozzolan is used) strength of the concrete is 8000 psi or above.

2.3.2 Testing By Government

Facilities shall be made available to the Government Representative for making and testing any additional test cylinders desired.

2.3.3 Certificates of Compliance

The Contractor shall certify that admixtures, aggregates, cement, and pozzolan used conform with their requirements of the specifications. Manufacturer's literature indicating conformance may be submitted for admixtures.

PART 3 EXECUTION

3.1 PILE DRIVING EQUIPMENT

The Contractor shall select the proposed pile driving equipment as specified and submit descriptions of the proposed equipment for approval. Equipment approval will be based on wave equation analysis submitted by the Contractor for approval and the engineering judgment of the Government Representative. Stresses predicted by wave equation analysis shall not exceed 0.85 times the concrete compressive strength minus the effective prestress in compression and the effective prestress in tension. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be allowed after the equipment has been approved by the Government Representative except as directed by the Government Representative. No additional contract time will be allowed for Contractor proposed changes in the equipment.
3.1.1 Pile Driving Hammers

Pile driving hammers shall be of the impact type and capable of satisfying the requirement of paragraph "Penetration Criteria". Hammers shall be steam or air of the single acting, double-acting, or differential acting type. Boiler, compressor, or engine capacity shall be sufficient to operate hammers continuously at the full rated speed so that a single-acting hammer obtains a full upward stroke of the ram, a double-acting hammer operates at or near the blows per minute at which the hammer is rated, and a differential type hammer obtains a slight rise of the hammer base during each upward stroke. Single-acting hammers shall have a scale (in inches) fixed to the hammer's ram guide and a pointed indicator fixed on the ram to allow reading of the hammer's stroke. Both the scale and indicator shall be easily legible to observers on the ground. Hammers shall have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air and steam hammers. This gage shall be operational during the driving of piles and shall be mounted in an accessible location for monitoring by the Contractor and the Government Representative.

3.1.2 Pile Driving Leads

Leads shall align the pile and hammer concentrically, and maintain the pile in proper position and alignment throughout driving. Hammers shall be supported and guided with fixed extended leads or fixed underhung leads. For driving battered piles, hammers shall be supported and guided with fixed extended leads capable of achieving the batters shown on the plans fore and aft batter and side batter as shown on the plans, with 30-degree rotation each side of an axis running along the center line of rotation of the crane through the center line of the leads. The leads shall be of sufficient length to fully accommodate the combined length of the pile and hammer. Two intermediate pile supports shall be provided in the leads to reduce the unbraced length of the pile during driving and pulling.

3.1.3 Driving Helmets and Pile Cushions

A driving helmet including a pile cushion shall be used between the top of the pile and the ram to prevent impact damage to the pile. The driving helmet and pile cushion combination shall be capable of protecting the head of the pile, minimize energy absorption and dissipation, transmit hammer energy uniformly over the top of the pile and prevent excessive tensile stresses from developing in the concrete during driving. The driving helmet shall fit loosely around the top of the pile so that the pile is not restrained by the helmet if the pile tends to rotate during driving. The pile cushion may be of solid wood or of laminated construction, completely cover the top surface of the pile, and be retained by the driving helmet. Minimum thickness of the pile cushion shall be 3 inches and the thickness shall be increased so as to be suitable for the size and length of pile, character of subsurface material to be encountered, hammer characteristics, and the required driving resistance.

3.1.4 Cap Blocks

The cap block (hammer cushion) used between the driving cap and the hammer ram may be of solid hardwood block with grain parallel to the pile axis and enclosed in a close-fitting steel housing or may consist of aluminum and approved industrial type plastic laminate disks stacked alternately in
a steel housing. Steel plates shall be used at the top and the bottom of the cap block. The cap block shall be replaced if it has been damaged, highly compressed, charred, or burned or has become spongy or deteriorated in any manner. If a wood cap block is used, it shall not be replaced during the final driving of any pile. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy be permitted.

3.1.5 Pile Extractors

Impact hammers are required for pulling piles.

3.2 INSTALLATION

3.2.1 Lengths of Permanent Piles

The estimated quantities of piles listed in the unit price schedule are given for bidding purposes only.

3.2.2 Pile Placement and Tolerances

A pile placement plan shall be developed to show the installation sequence and the methods proposed for controlling the location and alignment of piles and submitted for approval. Piles shall be placed accurately in the correct location and alignments, both laterally and longitudinally, and to the vertical or batter lines indicated. The Contractor shall establish a permanent baseline during pile driving operations to provide for inspection of pile placement by the Government Representative. The baseline shall be established prior to driving permanent piles and shall be maintained during the installation of the permanent piles. Prior to driving and with the pile head seated in the hammer, the Contractor shall check each pile for correct alignment. The alignment of battered piles shall be checked and monitored during driving with an accurate batter board level. A final lateral deviation from the correct location at the cutoff elevation of not more than 3 inches will be permitted. A vertical deviation from the correct cutoff elevations shown on the drawing of not more than 2 inch(es) will be permitted. A final variation in slope of not more than 1/4 inch per foot of longitudinal axis will be permitted. The correct relative position of all piles shall be maintained by the use of templates or by other approved means. Piles not located properly or exceeding the maximum limits for rotation, lateral deviation, and/or variation in alignment shall be pulled and redriven at a directed location.

3.2.3 Pile Driving

Piles shall not be driven within 100 feet of concrete less than 7 days old nor within 30 feet of concrete less than 28 days old unless otherwise authorized. Driving shall not result in cracking, crushing, or spalling of concrete. The sequence of installation shall be such that pile heave is minimized. Where heave is anticipated, pile driving shall start at the center of the group and proceed outward and vertical piles shall be driven prior to those battered where practicable. The Government Representative shall be notified 30 days prior to the date driving is to begin.

3.2.3.1 Driving Records

The Contractor shall develop driving record forms for recording the pile driving operations, obtain approval of this form, and compile complete records of the operations. Pile driving records shall include pile
dimensions and location, pile identification number, casting date, date driven, original pile length, cutoff and tip elevations, batter alignment, description of hammer used, rated hammer energy, observed stroke and rate of hammer operation (blows per minute), length of pressure hose, penetration under the combined weight of the pile and hammer, number of blows required for each foot of penetration throughout the entire length of each pile and for each inch of penetration in the last foot of penetration, time for start and finish of driving, total driving time in minutes and seconds for each pile, cushion information including changes during driving, and any other information as required or requested. Record shall also include information such as unusual driving conditions, interruptions or delays during driving, observed pile damage, heave detected in adjacent piles, records of restriking, depth and description of voids formed adjacent to the pile, and any other pertinent information.

3.2.3.2 Penetration Criteria

Piles shall be driven to the required as shown on the drawings or until the maximum permissible blow count is exceeded. The maximum permissible blow count shall be established from wave equation analyses so that stresses in the pile are limited to 0 psi in tension and 0.85 times the compressive strength in compression.

3.2.3.3 Driving

Permanent and test piles shall be driven with hammers of the same model and manufacturer, same energy and efficiency, and using the same driving system. The hammer shall be operated at all times at the speed and under the conditions recommended by the manufacturer subject to the approval of the Government Representative. Once pile driving has begun, conditions such as alignment and batter shall be kept constant. Each pile shall be driven continuously and without interruption until the required depth of penetration has been attained. Deviation from this procedure will be permitted only for necessary changes to the pile cushion or whenever driving is stopped by causes that reasonably could not have been anticipated. Pile cushion changes will be considered necessary whenever the cushion has become highly compressed, charred, burned, or deteriorated. Changes to the cushion will not be allowed near the end of driving. A pile that cannot be driven to the required depth because of an obstruction, as indicated by a sudden unexplained change in blow count and drifting, shall be pulled and redriven or shall be cut off and abandoned, whichever is directed.

Observations shall be made to detect heave in accordance with paragraph "Heaved Piles". After piles are driven, the driving head or any excess pile above the cutoff elevation shall be removed in accordance with paragraph "Cutting of Piles".

a. Scale - A scale (inches) shall be fixed to the hammer's ram guide and a pointed indicator on the ram, near the scale, to allow a reading of the ram drop (see example diagram at the end of this section). Installation of both scale and indicator shall be in such a manner that the drop of the ram can be read by observing the highest and the lowest position of the indicator and scale. Both the scale and the indicator shall be easily legible to observers on the ground during operations. The Contractor shall record in the pile driving record the ram drop of the pile hammer when recording the blows per foot as specified herein.
3.2.3.4 Heaved Piles

When driving piles in clusters or under conditions of relatively close spacing, observations shall be made to detect heave of adjacent piles. Heaved piles shall be driven to the original penetration criteria.

3.2.3.5 Pulled Piles

Piles damaged or impaired for use during driving shall be pulled and replaced with new piles, or shall be cut off and abandoned and new piles driven as directed. The Government Representative may require that any pile be pulled for inspection. Piles pulled at the direction of the Government Representative and found to be in suitable condition shall be redriven at a directed location.

3.2.3.6 Jetting

Jetting of piles will not be permitted.

3.2.3.7 Preboring

Preboring will not be allowed.

3.2.3.8 Void Backfill

Voids occurring around piles as a result of pile driving or due to any other cause and abandoned holes for piles that have been pulled shall be filled to within 3 feet of the adjacent ground surface with a tremie-placed slurry (from bottom to top of hole). The slurry shall consist of one part portland cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids. The upper 3 feet of the hole shall be filled with earth and compacted to the same density as the surrounding soil.

3.2.4 Cutting of Piles

The proposed method for cutting of piles for removal of driving heads must be approved and shall not damage the pile concrete or reinforcement steel left in place. The use of explosives will not be permitted. Driving heads shall not be removed until heaved piles are redriven to the original penetration criteria. Cut off sections of piles shall be removed from the site upon completion of the work.

3.2.5 Splicing

Splicing of driven piles will not be permitted.

3.2.6 Build-Ups

The Government Representative may direct the Contractor to repair pile tops damaged during driving by removing the damaged portion and adding a reinforced concrete build-up. Build-ups shall be constructed subsequent to final seating of piles. Build-ups shall conform to the requirements of paragraph "Build-Ups."

-- End of Section --
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SECTION 31 62 14.00 12

PILE LOAD TESTS

03/09

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor, and materials, and performing all operations in driving reaction piles, testing piles, pulling, and removing of reaction piles, in accordance with these specifications and as shown on the drawings. Test methods described herein are in accordance with ASTM D1143D and ASTM D3689. The Contractor shall submit his plan for conducting tests to the Government Representative for approval a minimum of 15 days prior to the beginning of the tests. The test pile sites are located on the drawings. Piles are specified in Section 31 62 13.20 12 PRESTRESSED CONCRETE PILES and Section 31 62 16.00 12 STEEL H-PILES.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The following publications, referred to thereafter by basic designation only, form a part of this specification to the extent indicated:

ASTM INTERNATIONAL (ASTM)


1.4   QUALITY CONTROL

1.4.1   General

The Contractor shall establish and maintain quality control for all operations to assure compliance with the contract requirements and maintain records of his quality control for all construction operations including, but not limited to, the following:

(1) Facilities and personnel providing for installation and reading by the Contractor of all measuring devices.

(2) Compression test (pile number, location); loading frames and description (number, size, type, and location of supporting piles); sequence and method of loading; records of measurements, and driving records.

(3) Tension test (pile number, location); description of loading yoke
and yoke installation (number, size, type, and location of supporting piles); sequence and method of loading; records of measurements, and driving records.

1.4.2 Reporting

Format of reports other than test data shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL. The original and three (3) copies of these records and tests, as well as records of corrective action taken, shall be furnished to the Government daily.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pile Test Procedures; G

The Contractor shall submit a detailed plan of the pile test procedure to the Government Representative a minimum of 20 days prior to the pile driving and setup.

Loading Frames, Pile Lateral Support, and Testing Procedure; G

The Contractor shall furnish his loading frame set-up and lateral support with computations used in the design of the loading frame and lateral support, and his plan for conducting the pile test to the Government Representative for approval.

SD-03 Product Data

Pile Test Equipment Calibration; G

Descriptions of pile driving equipment, including leads and extractors shall be submitted for approval at least 30 days prior to commencement of work. The following information for each hammer proposed shall be submitted for each proposed hammer:

1. make and model
2. ram weight (pounds)
3. anvil weight (pounds)
4. weight of the moving parts of the hammer (pounds)
5. rated stroke (inches)
6. rated energy range (foot-pounds)
7. rated speed (blows per minute)
8. steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
9. power pack description
10. pile driving helmet, make, and weight (pounds)
11. pile cushion material, type, proposed thickness, modulus of elasticity, and coefficient of restitution
12. the make-up of the proposed cap block, including material type, dimensions, modulus of elasticity, and coefficient of restitution
(13) rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch)

SD-05 Design Data

Pile Test Setup Design; G

The Contractor shall submit drawings and design computations for the pile test setup. The design computations shall include, but not be limited to loading frame design, lateral support design, and design of support/reaction piles. Pile test setup design shall be submitted to the Government Representative a minimum of 7 days prior to pile driving and setup.

SD-06 Test Reports

Pile Test Data

The Contractor shall furnish all data from each pile tested including the pile driving records as required in Section 31 62 13.20 12 PRESTRESSED CONCRETE PILES and Section 31 62 16.00 12 STEEL H-PILES within 24 hours after completion of each test. If a test pile fails at or less than 200 percent of the service load, preliminary field test data shall be provided to the Government Representative within 4 hours of the completion of the test. Blow counts shall be recorded for each foot of each test pile and furnish copies to the Government Representative. The Pile Driving Report shall include, but not be limited to; unusual driving conditions, interruptions or delays during driving, and any other information considered pertinent. Pile test data shall be recorded for all items shown in paragraph "Reports." Copies of these forms shall also be furnished to the Government Representative.

Pile Test Equipment Calibration

The Contractor shall furnish calibration curves (before and after testing program) of the hydraulic jack and load cell as required in paragraph "Apparatus for Applying Pile Load and Measuring Movement".

1.6 TEST MEASUREMENT

Measurements of compression and tension loads, deflections and settlements, of the test piles and reports on all test piles shall be made by the Contractor. The lengths of steel H-piles and prestressed concrete piles, as determined by the result of the load tests, shall be determined by the Government Representative and furnished to the Contractor within 15 days after receipt of the last test report.

1.7 REPORTS

The report of the load test shall include the following items where applicable:

1.7.1 General

(1) Project Identification
(2) Location

1.7.2 Pile Installation Equipment

(1) Make, model, type, and size of hammer
(2) Weight of hammer and ram
(3) Stroke of ram
(4) Rated energy and operating speed of hammer
(5) Type and thickness of cap blocks and pile cushions
(6) Weight and dimensions of drive-cap and follower

1.7.3 Test and Support Piles

(1) Identification of test pile(s)
(2) Type of piles
(3) Pile material including basic specifications
(4) Dimensions of pile
(5) Pile weight as driven
(6) Which piles vertical-batter
(7) Degree of batter
(8) Driven length
(9) Embedded length
(10) Tested length, and
(11) Final elevation of piles butt referenced to fixed datum (identify datum)

1.7.4 Pile Installation - Test and Support

(1) Date driven
(2) Operating of hammer during final driving
(3) Driving log, blows per foot
(4) Final penetration resistance, blows per inch
(5) Description of special installation procedures used, and
(6) Notation of any unusual occurrences during installation

1.7.5 Pile Testing

(1) Date tested
(2) Type of test pile
(3) Type of load application apparatus
(4) Number of support piles of each test
(5) Instrumentation used to measure pile movement (serial numbers of the hydraulic ram, load cell, extensometers, and level used for each test shall be recorded on the data sheet).
(6) Special testing procedures used
(7) Temperature and weather conditions during test
(8) Tabulation of all load-time-movement reading
(9) Gages, scales, and reference points identified
(10) Adjustment made to field data and explanation
(11) Notation of any unusual occurrences during test, and
(12) Test jack and other required calibration reports

PART 2 PRODUCTS

2.1 TYPES AND PROPERTIES

Steel H-piles shall conform to the requirements of Section 31 62 16.00 12 STEEL H-PILES. Prestressed concrete piles shall conform to the requirements of Section 31 62 13.20 12 PRESTRESSED CONCRETE PILES. Tip elevations for test piles are shown on the drawings.

PART 3 EXECUTION

3.1 PLACING AND DRIVING TEST PILES

The Contractor shall submit Pile Test Procedures, Pile Test Setup Design, and Pile Test Equipment Calibration to the Government Representative for approval a minimum of 20 days prior to the pile driving and setup. Test piles shall be driven in accordance with the requirements of Section 31 62 16.00 12 STEEL H-PILES and Section 31 62 13.20 12 PRESTRESSED CONCRETE PILES.

3.2 TEST PILE LOADING

3.2.1 Scope

This part covers procedures for testing vertical foundation piles to determine the response of the pile to a static compressive or tensile load applied axially to the pile. The Contractor shall submit Loading Frames, Pile Lateral Support, and Testing Procedure to the Government Representative for approval prior to the tests. Determination of the allowable compression and tensile load for the pile is made by the incremental loading and measurement of the pile deformation. The Contractor shall drive all test and reaction piles prior to starting the load tests. The longer piles at a given pile test location shall be driven prior to installation of the shorter pile. The Engineer may reduce or
increase the length of the piles scheduled to be at the design pile tip elevation depending on the driving conditions of the longer piles. Where a compression test and a tension test are performed on the same pile, the compression test shall be performed first. Tension tests shall be begin for a minimum of 21 days after completion of a compression test for any given pile. Once the Contractor begins running the pile load tests, the testing shall continue seven (7) days a week until the last test is complete.

3.2.1.1 Compression Test

Test piles shall be furnished in the lengths required and driven as directed by the Government Representative at the location shown on the drawings. A minimum time period of 21 days shall be allowed to elapse between driving of the test piles, including driving of the reaction piles, and the initiation of a compression test. There will be no payment nor additional time granted for delays incurred between driving of test piles and initiation of pile tests.

3.2.1.2 Tension Test

Test piles shall be furnished in the lengths required and driven as directed by the Government Representative at the location shown on the drawings. A minimum time period of 21 days shall be allowed to elapse between driving of the piles and reaction piles and the initiation of a tension test. There will be no payment nor additional time granted for delays incurred between driving of test piles and initiation of pile tests.

3.2.2 General Procedures

The Contractor shall provide and be responsible for furnishing all necessary apparatus, measuring equipment, and personnel to install, test, and extract the test piles described within this specification in its entirety. The recording and reporting of all data shall be the responsibility of the Contractor. However, the Government Representative shall have free access to the pile test data at any time. A Government Representative will be present during the load tests. The Contractor shall provide the Government Representative 72 hours notice prior to initiating each pile load test in order that arrangements may be made to have a Government Representative present during the test. The reduction, analysis, and interpretation of the test data will be accomplished by Government personnel after completion of each pile test. Additional pile tests, as described herein, or otherwise may be required as determined by the Government Representative. In order to prevent disturbances to the instrumentation readings, construction activities, equipment movement, or operation of construction equipment, will not be permitted within 200 feet of any load test in progress.

3.2.3 Loading Frames

For illustration purposes, the loading frames for applying known compressive loads to a pile are shown on the drawings. Loading frames shall be constructed so that the loads are applied axially to minimize eccentric loading. Design considerations such as sizes, numbers, and material of specific beams, support piles, bearing plates, etc., shall be the responsibility of the Contractor and subject to approval of the Government Representative. Included with his plan for conducting the tests, the Contractor shall submit computations used in the design of the loading frame. The computations shall be stamped by a registered
professional engineer in the State of Louisiana. For the compression test, a steel bottom bearing plate of appropriate thickness for the loads involved shall not be less than the size of the pile butt, nor less than the area covered by the base of the hydraulic jack. A top bearing plate shall have a size not less than the load cell head, nor less than the total width of the reactor beam(s). For the tension load test, the Contractor shall design the pile tension connection, and it shall be subject to the approval of the Government Representative. The support piles for the loading frame shall be placed at least five times the maximum diameter of the largest support or test pile, but in no case less than a clear distance of 8 feet. The box or platform shall be loaded with any suitable material such as soil, rock, concrete, steel, or water filled tanks with a total weight (including that of the test beams(s) and box or platform) at least 10 percent greater that the anticipated maximum test load. Each load frame shall be designed to support at least 300 percent of the service load (see project drawings for test pile and service load details). The Contractor shall retest the test pile at no additional cost to the Government if failure occurs to the reaction piles or reaction frames prior to the failure of the test pile.

3.2.4 Pile Lateral Support during Load Testing

The Contractor shall provide all necessary lateral bracing/lateral support of the test pile within the casing during pile load test. The Contractor shall submit calculations stamped by a registered engineer exhibiting analysis and design of any required bracing when the pile is subject to the maximum test load. The lateral bracing/support shall provide support in all directions without restricting vertical movement. The support is only required for the load test, not for installation.

3.2.5 Apparatus for Applying Pile Load and Measuring Movement

All equipment related to the load test (extensometers, level, load cell, hydraulic jack, scales, mirrors, etc.) and testing shall be furnished and operated by the Contractor. All pile test equipment calibration shall be submitted for approval at least 30 days prior to commencement of work. Typical apparatus setup is depicted on the drawings. The hydraulic jack shall be equipped with a pressure reading gage calibrated in tons and with a ram having a spherical bearing head to minimize eccentric loading. The jack shall be capable of maintaining constant loads between load changes and shall be calibrated prior to the test so that the load applied is controllable to within 5 percent. The load cell (non-self-leveling) shall be an electric strain gage type equipped with a readout device. Load cells shall be calibrated prior to the test to an accuracy within 2 percent of the applied load. The changing and maintaining of loads on each test pile shall be done utilizing the load cell as the primary loading device and pressure gage on the jack as a backup. However, both readings shall be recorded. Extensometers shall be used to measure pile movement and shall have dial gages with stems having at least a 2-inch travel, or sufficient gage blocks shall be provided to allow this travel with shorter gage stems. Gages shall be read to an accuracy of 0.001 inch. Smooth bearing surfaces perpendicular to the direction of the measurements shall be provided for by the gage stems. The hydraulic jack, load cell, and extensometers shall be calibrated both before the start and after the completion of the testing program, by a certified testing laboratory for both the loading and unloading cycles and calibration curves furnished to the Government Representative. The calibration curves shall be load cell strain readings versus load in tons. In developing the calibration curves, the load cell shall be placed above the jack in the testing
machine and the loads shall be applied through the ram to the load cell to the testing machine in the actual working manner of the field loading system. Two reference beams, one on each side of the pile, shall be independently supported with supports firmly embedded in the ground at a clear distance of not less than 8 feet from the test pile, and 7 to 8 feet from the support piles. Reference beams shall be of sufficient stiffness to prevent excessive deflections. Reference beam stakes shall have firmly embedded in the ground. If steel reference beams are used, one end of each beam shall be free to move as the length of the beams change with temperature variations. As a backup to the extensometers, an engineer's level and scale shall be used to check the movement of the test pile. The level shall also be used to check the movement of the support piles. Scales used to measure pile movements shall read to 1/64th of an inch or to 0.01 inch. Target rods shall read 0.001 foot. All dial gages, scales, and reference points shall be clearly marked with a reference number or letter to assist in recording data accurately. Readings from the surveyor's level may be taken on a target rod or a scale and shall be referenced to two permanent benchmarks located outside the immediate test area or the surveyor's level shall be mounted on an object of fixed elevation (for example, a driven pile) outside of the immediate test area. Readings shall be taken on two fixed points or scales on opposite sides of the pile or pile cap or on a single fixed point or scale in the center of the pile top or pile cap. Readings shall be taken on a sufficient number of support piles and on the reference beams to establish if there is any movement. A water-resistant tarpaulin of minimum dimension of 12 feet x 12 feet shall be installed by the Contractor to protect at all times the instrumentation, measuring system, and prevent adverse temperature variations.

3.2.6 Loading Procedure and Measurement of Pile Movement

The anticipated service loads for the test are shown on the drawings. After the test piles and reaction piles are driven, the Contractor shall allow a time period of not less than 21 days to elapse before loading the test piles. Apply loads to the piles in increments of 25 percent of the anticipated service load until 200 percent of the service load is reached or until failure, which ever occurs first. The rate of application and removal of load shall be 2 tons per minute. The Contractor shall take readings of time, load, and movement and record them for each load increment or load decrement. When the 25 percent increment has been reached, the Contractor shall maintain the load for 2 hours and readings shall be taken at the 2-minute, 8-minute, 15-minute, 30-minute, 60-minute, and 120-minute intervals. After the application of loads equal to 50, 100, and 150 percent of the test load, remove the applied load in each case in decrements equal to the loading increments with 20 minutes between decrements. After removing each total applied load, reapply the load to the previous load level in increments equal to 50 percent of the test load with 20 minutes between increments. When the previous load level has been obtained, increase load in 25 percent increments to the next load level. When 200 percent of the service load has been applied and failure has not occurred, allow the 200 percent service load to remain on the pile for 24 hours, except in the event that the average rate of settlement is greater than 0.01 inch/hour, hold the total load on the pile for 48 hours. During this time, readings shall be taken every hour. After the required holding time, remove the load in decrements of 50 percent of the service load with 1 hour between decrements. After the load has been applied and removed in accordance with the above, reload the pile to 200 percent of the service load in increments of 50 percent, allowing 20 minutes between increments. The Contractor shall then increase the load in increments of 10 percent of
the service load until failure occurs or the applied load reaches 300 percent of the service load. The time lapse between increments shall be 20 minutes. If failure does not occur, hold the full load for 2 hours at which time remove the load in four equal decrements, allowing 20 minutes between decrements. For purposes of stopping pile tests in progress, failure is achieved when the full extent of the extensometers is reached. If failure occurs before the load reaches 300 percent of the service load then the load shall be removed in 4 equal decrements allowing 20 minutes between decrements. The Contractor shall submit pile test setup design and pile test data for approval. Test apparatus shall not be removed from the pile until approval is received from the Government representative. To illustrate the loading and pile measurement procedures, a sample test schedule is provided following this paragraph.

**SAMPLE OF COMPRESSION PILE TEST SCHEDULE**

<table>
<thead>
<tr>
<th>Load (Tons)</th>
<th>Elapsed Time</th>
<th>Incremental Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0:00</td>
<td>0 min.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0:03</td>
<td>3 min. (load rate 2 tons/min)</td>
<td>25% service load</td>
</tr>
<tr>
<td>5</td>
<td>0:05</td>
<td>2 min.</td>
<td>Take Reading (TR)</td>
</tr>
<tr>
<td>5</td>
<td>0:11</td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0:18</td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0:33</td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1:03</td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2:03</td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2:06</td>
<td>3 min.</td>
<td>50% service load</td>
</tr>
<tr>
<td>10</td>
<td>2:08</td>
<td>2 min.</td>
<td>TR</td>
</tr>
<tr>
<td>10</td>
<td>2:14</td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2:21</td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2:36</td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
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<td>3:06</td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>4:06</td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
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<td>Decrement 25% service load (TR)</td>
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<td>TR</td>
</tr>
<tr>
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<td>3 min.</td>
<td>Decrement 0% service load (TR)</td>
</tr>
<tr>
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<td>4:52</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>10</td>
<td>4:57</td>
<td>5 min.</td>
<td>Increment 50%</td>
</tr>
<tr>
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<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>15</td>
<td>5:20</td>
<td>3 min.</td>
<td>75% service load</td>
</tr>
<tr>
<td>15</td>
<td>5:22</td>
<td>2 min.</td>
<td>TR</td>
</tr>
<tr>
<td>15</td>
<td>5:28</td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>5:35</td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>5:50</td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>6:20</td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>7:20</td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>7:23</td>
<td>3 min.</td>
<td>100% service load</td>
</tr>
<tr>
<td>20</td>
<td>7:25</td>
<td>2 min.</td>
<td>TR</td>
</tr>
<tr>
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<td>7:31</td>
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<td></td>
</tr>
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<td>7:38</td>
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<td>7:53</td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>8:23</td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>9:23</td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>9:26</td>
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<td>Decrement 75% service load (TR)</td>
</tr>
<tr>
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<td>9:46</td>
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</tr>
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<td>Load (Tons)</td>
<td>Elapsed Time</td>
<td>Incremental Time</td>
<td>Remarks</td>
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</tr>
<tr>
<td>10</td>
<td>9:49</td>
<td>3 min.</td>
<td>Decrement 50% service load (TR)</td>
</tr>
<tr>
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<td>10:09</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>Load (Tons)</td>
<td>Elapsed Time</td>
<td>Incremental Time</td>
<td>Remarks</td>
</tr>
<tr>
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<td>---------</td>
</tr>
<tr>
<td>0</td>
<td>10:14</td>
<td>5 min.</td>
<td>Decrement 0% service load (TR)</td>
</tr>
<tr>
<td>10</td>
<td>10:34</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>10</td>
<td>10:39</td>
<td>5 min.</td>
<td>Increment 50% service load</td>
</tr>
<tr>
<td>20</td>
<td>11:04</td>
<td>5 min.</td>
<td>Increment 100% service load</td>
</tr>
<tr>
<td>25</td>
<td>11:24</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>25</td>
<td>11:27</td>
<td>3 min.</td>
<td>125% service load</td>
</tr>
<tr>
<td>30</td>
<td>13:30</td>
<td>3 min.</td>
<td>150% service load</td>
</tr>
<tr>
<td>25</td>
<td>15:33</td>
<td>3 min.</td>
<td>Decrement 125% service load (TR)</td>
</tr>
<tr>
<td>20</td>
<td>15:56</td>
<td>3 min.</td>
<td>Decrement 100% service load (TR)</td>
</tr>
<tr>
<td>10</td>
<td>16:16</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>0</td>
<td>16:46</td>
<td>5 min.</td>
<td>Decrement 0% service load (TR)</td>
</tr>
<tr>
<td>10</td>
<td>17:06</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>20</td>
<td>17:36</td>
<td>5 min.</td>
<td>Increment 100% service load</td>
</tr>
<tr>
<td>30</td>
<td>18:01</td>
<td>5 min.</td>
<td>Increment 150% service load</td>
</tr>
<tr>
<td>35</td>
<td>18:21</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>35</td>
<td>18:24</td>
<td>3 min.</td>
<td>175% service load</td>
</tr>
<tr>
<td>18:26</td>
<td>2 min.</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>18:32</td>
<td>8 min.</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>18:39</td>
<td>15 min.</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>18:54</td>
<td>30 min.</td>
<td>&quot;</td>
<td></td>
</tr>
</tbody>
</table>
### SAMPLE OF COMPRESSION PILE TEST SCHEDULE

<table>
<thead>
<tr>
<th>Load (Tons)</th>
<th>Elapsed Time</th>
<th>Incremental Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19:24</td>
<td>60 min.</td>
<td></td>
<td>TR</td>
</tr>
<tr>
<td>20:24</td>
<td>120 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>20:27</td>
<td>3 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20:29</td>
<td>2 min.</td>
<td>Continue to hold load for 24 hours.</td>
</tr>
<tr>
<td></td>
<td>20:35</td>
<td>8 min.</td>
<td>If settlement is greater than .01 inch/hour hold</td>
</tr>
<tr>
<td></td>
<td>20:42</td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20:57</td>
<td>30 min.</td>
<td>load for 48 hours.</td>
</tr>
<tr>
<td></td>
<td>21:27</td>
<td>60 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>22:27</td>
<td>120 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>23:27</td>
<td>3 hr.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>0:27</td>
<td>4 hr.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>1:27</td>
<td>5 hr.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>19:27</td>
<td>23 hr.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>20:27</td>
<td>24 hr.</td>
<td>&quot;</td>
</tr>
<tr>
<td>30</td>
<td>20:32</td>
<td>5 min.</td>
<td>Decrement 150% service load (TR)</td>
</tr>
<tr>
<td></td>
<td>20:52</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>21:12</td>
<td>40 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>21:32</td>
<td>60 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td>20</td>
<td>21:37</td>
<td>5 min.</td>
<td>Decrement 100% service load (TR)</td>
</tr>
<tr>
<td></td>
<td>21:57</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>22:17</td>
<td>40 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>22:37</td>
<td>60 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td>10</td>
<td>22:42</td>
<td>5 min.</td>
<td>Decrement 50% service load (TR)</td>
</tr>
<tr>
<td></td>
<td>23:02</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>23:22</td>
<td>40 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>23:42</td>
<td>60 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td>0</td>
<td>23:47</td>
<td>5 min.</td>
<td>Decrement 0% service load (TR)</td>
</tr>
<tr>
<td></td>
<td>0:07</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>0:27</td>
<td>40 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>0:47</td>
<td>60 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td>10</td>
<td>0:52</td>
<td>5 min.</td>
<td>Increment 50% service load</td>
</tr>
<tr>
<td></td>
<td>1:12</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>20</td>
<td>1:17</td>
<td>5 min.</td>
<td>Increment 100% service load</td>
</tr>
</tbody>
</table>
SAMPLE OF COMPRESSION PILE TEST SCHEDULE

<table>
<thead>
<tr>
<th>Load (Tons)</th>
<th>Elapsed Time</th>
<th>Incremental Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1:37</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>1:42</td>
<td>5 min.</td>
<td>Increment 150% service load TR</td>
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<tr>
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<td>2:02</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
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<td>2:07</td>
<td>5 min.</td>
<td>Increment 200% TR</td>
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<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
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<td>2:28</td>
<td>1 min.</td>
<td>Increment 210% TR</td>
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<td>TR</td>
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<tr>
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<td>1 min.</td>
<td>Increment 220% TR</td>
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<td>TR</td>
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<td>1 min.</td>
<td>Increment 230% TR</td>
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<tr>
<td>48</td>
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<td>TR</td>
</tr>
<tr>
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<td>3:31</td>
<td>1 min.</td>
<td>Increment 240% TR</td>
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<tr>
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<td>3:51</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
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<td>3:52</td>
<td>1 min.</td>
<td>Increment 250% TR</td>
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<td>52</td>
<td>4:12</td>
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<td>TR</td>
</tr>
<tr>
<td></td>
<td>4:13</td>
<td>1 min.</td>
<td>Increment 260% TR</td>
</tr>
<tr>
<td>54</td>
<td>4:33</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
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<td>4:34</td>
<td>1 min.</td>
<td>Increment 270% TR</td>
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<tr>
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<td>4:54</td>
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<td>TR</td>
</tr>
<tr>
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<td>4:55</td>
<td>1 min.</td>
<td>Increment 280% TR</td>
</tr>
<tr>
<td>58</td>
<td>5:15</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>5:16</td>
<td>1 min.</td>
<td>Increment 290% TR</td>
</tr>
<tr>
<td>60</td>
<td>5:36</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>5:37</td>
<td>1 min.</td>
<td>Increment 300% service load TR</td>
</tr>
<tr>
<td></td>
<td>5:37</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td></td>
<td>6:17</td>
<td>40 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>6:37</td>
<td>60 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>6:57</td>
<td>80 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>7:17</td>
<td>100 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>7:37</td>
<td>120 min.</td>
<td>&quot;</td>
</tr>
<tr>
<td>45</td>
<td>7:45</td>
<td>8 min.</td>
<td>Decrement 75% (TR) TR</td>
</tr>
<tr>
<td>30</td>
<td>8:05</td>
<td>20 min.</td>
<td>TR</td>
</tr>
<tr>
<td>0</td>
<td>9:09</td>
<td>8 min.</td>
<td>Decrement 0% (TR) TR</td>
</tr>
</tbody>
</table>

END OF TEST

Loading and unloading time increments have been rounded upward to the nearest whole minute. Service load – 12.75 tons (SAMPLE).
### SAMPLE OF TENSION PILE TEST SCHEDULE

<table>
<thead>
<tr>
<th>Load (Tons)</th>
<th>Elapsed Time</th>
<th>Incremental Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0:00</td>
<td>0.0 min.</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>0:02</td>
<td>2 min.</td>
<td>25% service load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>2:04</td>
<td>2 min.</td>
<td>50% service load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>4:06</td>
<td>2 min.</td>
<td>Decrement 25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4:28</td>
<td>2 min.</td>
<td>Decrement 0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>4:52</td>
<td>4 min.</td>
<td>Increment 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>9.6</td>
<td>5:14</td>
<td>2 min.</td>
<td>75% service load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>12.75</td>
<td>7:16</td>
<td>2 min.</td>
<td>100% service load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 min.</td>
<td></td>
</tr>
<tr>
<td>9.6</td>
<td>9:18</td>
<td>2 min.</td>
<td>Decrement 75%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>9:40</td>
<td>2 min.</td>
<td>Decrement 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>10:04</td>
<td>4 min.</td>
<td>Decrement 0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>10:28</td>
<td>4 min.</td>
<td>Increment 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>12.75</td>
<td>10:52</td>
<td>4 min.</td>
<td>Increment 100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 min.</td>
<td></td>
</tr>
</tbody>
</table>
### SAMPLE OF TENSION PILE TEST SCHEDULE

<table>
<thead>
<tr>
<th>Load (Tons)</th>
<th>Elapsed Time</th>
<th>Incremental Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.9</td>
<td>11:14</td>
<td>20 min.</td>
<td>125% service load</td>
</tr>
<tr>
<td></td>
<td>15:14</td>
<td>2 min.</td>
<td>125% service load</td>
</tr>
<tr>
<td></td>
<td>15:16</td>
<td>2 min.</td>
<td>125% service load</td>
</tr>
<tr>
<td></td>
<td>13:16</td>
<td>2 min.</td>
<td>150% service load</td>
</tr>
<tr>
<td>19.1</td>
<td>13:16</td>
<td>2 min.</td>
<td>150% service load</td>
</tr>
<tr>
<td>15.9</td>
<td>15:18</td>
<td>2 min.</td>
<td>Decrement 125%</td>
</tr>
<tr>
<td>12.75</td>
<td>15:40</td>
<td>2 min.</td>
<td>Decrement 100%</td>
</tr>
<tr>
<td>6.4</td>
<td>16:04</td>
<td>4 min.</td>
<td>Decrement 50%</td>
</tr>
<tr>
<td>0</td>
<td>16:28</td>
<td>4 min.</td>
<td>Decrement 0%</td>
</tr>
<tr>
<td>6.4</td>
<td>16:52</td>
<td>4 min.</td>
<td>Increment 50%</td>
</tr>
<tr>
<td>12.75</td>
<td>17:16</td>
<td>4 min.</td>
<td>Increment 100%</td>
</tr>
<tr>
<td>19.1</td>
<td>17:40</td>
<td>4 min.</td>
<td>Increment 150%</td>
</tr>
<tr>
<td>22.3</td>
<td>18:02</td>
<td>4 min.</td>
<td>175% service load</td>
</tr>
<tr>
<td></td>
<td>18:04</td>
<td>2 min.</td>
<td>200% service load</td>
</tr>
<tr>
<td></td>
<td>20:04</td>
<td>2 min.</td>
<td>Continue to hold</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 min.</td>
<td>load for 24 hrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 min.</td>
<td>If settlement is</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 min.</td>
<td>greater than</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 min.</td>
<td>.01 in/hr, hold</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 min.</td>
<td>load for 48 hrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 min.</td>
<td>3 hr.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 hr.</td>
<td>4 hr.</td>
</tr>
<tr>
<td>Load (Tons)</td>
<td>Elapsed Time</td>
<td>Incremental Time</td>
<td>Remarks</td>
</tr>
<tr>
<td>------------</td>
<td>--------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>19.1</td>
<td>20:08</td>
<td>4 min.</td>
<td>Decrement 150%</td>
</tr>
<tr>
<td>12.75</td>
<td>21:12</td>
<td>4 min.</td>
<td>Decrement 100%</td>
</tr>
<tr>
<td>6.4</td>
<td>22:16</td>
<td>4 min.</td>
<td>Decrement 50%</td>
</tr>
<tr>
<td>0</td>
<td>23:20</td>
<td>4 min.</td>
<td>Decrement 0%</td>
</tr>
<tr>
<td>6.4</td>
<td>0:24</td>
<td>4 min.</td>
<td>Increment 50%</td>
</tr>
<tr>
<td>12.75</td>
<td>0:48</td>
<td>4 min.</td>
<td>Increment 100%</td>
</tr>
<tr>
<td>19.1</td>
<td>1:12</td>
<td>4 min.</td>
<td>Increment 150%</td>
</tr>
<tr>
<td>25.5</td>
<td>1:36</td>
<td>4 min.</td>
<td>Increment 200%</td>
</tr>
<tr>
<td>26.8</td>
<td>1:57</td>
<td>1 min.</td>
<td>Increment 210%</td>
</tr>
<tr>
<td>28.0</td>
<td>2:18</td>
<td>1 min.</td>
<td>Increment 220%</td>
</tr>
<tr>
<td>29.3</td>
<td>2:39</td>
<td>1 min.</td>
<td>Increment 230%</td>
</tr>
<tr>
<td>30.6</td>
<td>3:00</td>
<td>1 min.</td>
<td>Increment 240%</td>
</tr>
<tr>
<td>31.9</td>
<td>3:21</td>
<td>1 min.</td>
<td>Increment 250%</td>
</tr>
<tr>
<td>33.2</td>
<td>3:42</td>
<td>1 min.</td>
<td>Increment 260%</td>
</tr>
<tr>
<td>34.4</td>
<td>4:03</td>
<td>1 min.</td>
<td>Increment 270%</td>
</tr>
</tbody>
</table>
### SAMPLE OF TENSION PILE TEST SCHEDULE

<table>
<thead>
<tr>
<th>Load (Tons)</th>
<th>Elapsed Time</th>
<th>Incremental Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.7</td>
<td>4:24</td>
<td>1 min.</td>
<td>Increment 280%</td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.0</td>
<td>4:45</td>
<td>1 min.</td>
<td>Increment 290%</td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38.2</td>
<td>5:06</td>
<td>1 min.</td>
<td>Increment 300%</td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.7</td>
<td>7:11</td>
<td>5 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.1</td>
<td>7:36</td>
<td>5 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.6</td>
<td>8:01</td>
<td>5 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>8:26</td>
<td>5 min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 min.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**END OF TEST**

Loading and unloading time increments have been rounded upward to the nearest whole minute. Service load - 12.75 tons (SAMPLE)

3.2.7 Additional Load Cycles

Any load cycles not accomplished in accordance with these specifications shall be redone at the direction of the Government Representative.

3.3 REMOVAL OF PILES

Test piles and reaction piles shall be cut-off to an elevation below foundation construction.

-- End of Section --
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DIVISION 31 - EARTHWORK

SECTION 31 62 14.01 12

DYNAMIC PILE TESTING

03/09

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1.2  MEASUREMENT AND PAYMENT
1.3  REFERENCES
1.4  QUALIFICATIONS
1.5  QUALITY CONTROL
   1.5.1  General
   1.5.2  Reporting
1.6  SUBMITTALS
1.7  TEST MEASUREMENT
1.8  REPORTS
   1.8.1  General
   1.8.2  Test Pile Installation Equipment
   1.8.3  Test Piles
   1.8.4  Test Pile Installation
   1.8.5  Dynamic Pile Testing

PART 2  PRODUCTS

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   2.1.2  Strain Transducers and Acceleration, Velocity or Displacement Transducers
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   3.1.2  Dynamic Testing During Restrike
3.2  APPLICATION
   3.2.1  Impact Force Application
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3.3  DYNAMIC TESTING REPORTS
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, equipment, power, labor, and materials, and performing all operations for dynamic pile testing of piles during initial driving and restriking steel piles in accordance with these specifications. Test methods described herein is in accordance with ASTM D4945. Dynamic pile testing is to provide data on strain or force and acceleration, velocity or displacement of a pile under impact force. The data shall be used to estimate the static capacity and the integrity of the pile, as well as hammer performance, pile stresses, and soil dynamic characteristics. The test pile sites are located on the drawings. Piles are specified in Section 31 62 16.00 12 STEEL H-PILES.

1.1.1   General

The Contractor shall retain the services of a geotechnical engineering firm experienced in the use of a pile driving analyzer and performing static pile load tests in similar subsurface foundation conditions as the subject test site. The Contractor shall provide and furnish all necessary apparatus, measuring equipment, personnel to install testing devices, and perform dynamic pile testing on indicator test piles in accordance with these specifications. The recording and reporting of all data shall be the responsibility of the Contractor. An experienced engineer shall operate the Pile Driving Analyzer in the field. All components of the apparatus for obtaining dynamic measurements and the apparatus for recording, reducing and displaying data shall be calibrated at least once every two (2) years to the standards of the manufacturer. The Government Representative shall have free access to the dynamic pile testing data at any time. A Government Representative will be present during the dynamic pile testing. The Contractor shall provide the Government Representative 48 hours notice prior to initiating each dynamic test in order that arrangements may be made to have a Government Representative present during the test. The reduction, analysis, and interpretation of the test data, and reports shall be accomplished by contractor's geotechnical firm.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
1.4 QUALIFICATIONS

The Contractor shall identify the geotechnical firm and individual within the geotechnical firm's organization who has the experience in the method of performing dynamic pile testing. The Contractor shall submit a proven experience record of the individual. As a minimum, the individual shall have the experience of performing dynamic pile testing on at least ten (10) projects of similar magnitude, and in similar subsurface soil conditions within the last five years. The individual proposed by the Contractor will be subject to the approval of the Government Representative and shall supervise all dynamic pile testing. Approval of the aforementioned individual does not exclude the Contractor from his obligation to perform the specified work.

1.5 QUALITY CONTROL

1.5.1 General

The Contractor shall establish and maintain quality control for all operations to assure compliance with the contract requirements and maintain records of his quality control for all construction operations including, but not limited to, the following:

(1) Facilities and personnel providing for installation and reading by the Contractor of all measuring devices.

(2) Dynamic Pile Testing (pile number, location); sequence and method of testing; records of measurements, and driving records.

(3) Ensure dynamic pile testing equipment is in good working order and calibrated before, during, and after gauges are attached to the pile.

(4) Perform data quality checks throughout the dynamic pile test and ensure data quality is reasonable reproducibly consistent and proportional.

(5) Restrike Dynamic Pile Testing (pile number, location); sequence and method of testing; records of measurements, and driving records.

1.5.2 Reporting

The original and two copies of these records and tests, as well as records of corrective action taken, shall be furnished to the Government daily.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

The Contractor shall furnish his loading frame set-up and
lateral support with computations used in the design of the loading frame and lateral support, and his plan for conducting the pile test to the Government Representative for approval.

Dynamic Pile Testing Work Plan; G

The Contractor shall submit his plan for conducting dynamic pile testing to the Government Representative for approval a minimum of 7 days prior to the beginning of the tests. The Contractor shall submit the items required below for review and approval by the Government Representative.

(1) Geotechnical firm and individual in the firm with the stated qualifications for performing dynamic pile testing.

(2) Dynamic Pile Testing Work Plan. The work plan shall include the following information:

   a. Number, and type transducers.
   b. Location and method of installing transducers.
   c. A description of sequence and method of dynamic testing during initial driving and restriking steel piles.

SD-03 Product Data

Pile Test Equipment Calibration; G

Descriptions of pile driving equipment, including leads, extractors, jetting equipment, and preboring equipment, shall be submitted for approval at least 30 days prior to commencement of work. The following information for each hammer proposed shall be submitted for each proposed hammer:

(1) make and model
(2) ram weight (pounds)
(3) anvil weight (pounds)
(4) weight of the moving parts of the hammer (pounds)
(5) rated stroke (inches)
(6) rated energy range (foot-pounds)
(7) rated speed (blows per minute)
(8) steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
(9) power pack description
(10) pile driving helmet, make, and weight (pounds)
(11) pile cushion material, type, proposed thickness, modulus of elasticity, and coefficient of restitution
(12) the make-up of the proposed cap block, including material type, dimensions, modulus of elasticity, and coefficient of restitution
(13) rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch)

SD-06 Test Reports

Pile Load Test Data

The Contractor shall furnish all data from each pile tested including the pile driving records as required in Section 31 62 14.01 12.
31 62 16.00 12 STEEL H-PILES within 24 hours after completion of each test. If a test pile fails at or less than 200 percent of the service load, preliminary field test data shall be provided to the Government Representative within 4 hours of the completion of the test. Blow counts shall be recorded for each foot of each test pile and furnish copies to the Government Representative. The Pile Driving Report shall include, but not be limited to; unusual driving conditions, interruptions or delays during driving, and any other information considered pertinent. Pile test data shall be recorded for all items shown in paragraph "Reports". Copies of these forms shall also be furnished to the Government Representative.

1.7 TEST MEASUREMENT

Measurements of compression and tension loads, deflections and settlements, of the test piles and reports on all test piles shall be made by the Contractor. Dynamic driving stresses of the piles tested shall be supplied to the Government Representative within seven (7) days after the installation of the piles.

1.8 REPORTS

The report of the load test shall include the following items where applicable:

1.8.1 General
   (1) Project Identification
   (2) Location

1.8.2 Test Pile Installation Equipment
   (1) Make, model, type, and size of hammer
   (2) Weight of hammer and ram
   (3) Stroke of ram
   (4) Rated energy and operating speed of hammer
   (5) Type and thickness of cap blocks and pile cushions
   (6) Weight and dimensions of drive-cap and follower

1.8.3 Test Piles
   (1) Identification of test pile(s)
   (2) Type of piles
   (3) Pile material including basic specifications
   (4) Dimensions of pile
   (5) Pile weight as driven
   (6) Which piles vertical-batter
(7) Driven length
(8) Embedded length
(9) Tested length, and
(10) Final elevation of piles butt referenced to fixed datum (identify datum)
(11) Location of splices, if applicable
(12) Dimensions and type of corrosion protection if applicable

1.8.4 Test Pile Installation

(1) Date driven
(2) Pre-excavation or jetting - depth, size, pressures, duration, etc.
(3) Operating of hammer during final driving
(4) Driving log, blows per foot
(5) Final penetration resistance, blows per inch
(6) Description of special installation procedures used, and
(7) Notation of any unusual occurrences during installation
(8) Cause and duration of interruptions in pile installation, if applicable

1.8.5 Dynamic Pile Testing

(1) Date tested description of all components of the apparatus for obtaining dynamic measurements and apparatus for recording, reducing and displaying data, and of test procedure including description and location of the sensor attachment.
(2) Date tested and sequence of indicator test pile such as "end of driving" or "beginning of restrike"
(3) Pile identification
(4) Pile length below sensors, cross sectional area, density, wave speed, and modulus of elasticity of the test pile
(5) Penetration resistance (number of blows per unit penetration) during test
(6) Graphical presentation of velocity and force measurement in the time domain for representative blow of each pile tested
(7) Method(s) and one-dimensional wave propagation theory used to evaluate data (particularly for the capacity evaluation)
(8) Capacity of the pile at the time of testing; at end of driving and from a restrike. Summarize variable for soil model, including damping
factors, quakes, and resistance distribution

(9) Hammer performance as measured by energy transferred into the pile
(10) Driving stresses in the pile
(11) Comments on the integrity of the pile, and
(12) Notation of any unusual occurrences during test.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Dynamic Monitoring Device

The dynamic monitoring device shall be a pile driving analyzer. The equipment shall conform to the requirements of ASTM D4945. The apparatus for obtaining dynamic measurements shall include transducers, which are capable of independently measuring strain and acceleration versus time at a specific location along the pile axis during the impact event. A minimum of four (4) strain transducers and four accelerometers, positioned at 90 degree around the perimeter of the pile, shall be secured attached to the pile to prevent slippage. Transducers and accelerometers shall be bolted to the test pile.

2.1.2 Strain Transducers and Acceleration, Velocity or Displacement Transducers

Transducers shall be as specified in ASTM D4945. The transducers shall have been calibrated to an accuracy of 3 percent throughout the applicable measurement range. If damage is suspected during use, the transducers shall be recalibrated or replaced.

2.1.3 Apparatus for Recording, Reducing, and Displaying Data

This apparatus shall be as described in ASTM D4945. The apparatus shall allow determination of the force and velocity versus time and determination of the acceleration and displacement of the pile head, and the energy transferred to the pile.

PART 3 EXECUTION

3.1 DYNAMIC TESTING

3.1.1 Dynamic Testing During Initial Driving

The Contractor shall submit Dynamic Pile Testing Work Plan and Pile Test Equipment Calibration to the Government Representative for approval a minimum seven (7) days prior to the pile driving and setup. Dynamic pile testing shall be performed during the initial driving of test piles as shown on the drawings. The Contractor shall mark the test piles clearly at appropriate interval for pile installation and dynamic testing. The Contractor shall attach a minimum of four (4) strain transducers and four accelerometers to the pile(s) at a minimum distance of 1.5 pile diameters below the pile head as stated in paragraph "Placement of Transducers and Accelerometers" and in accordance with ASTM D4945. The transducers shall be securely attached to the piles by bolting. The Contractor shall connect the sensors on the pile with the pile driving analyzer located at ground
level at a safe distance from the pile. The Contractor shall perform the internal calibration check and take the dynamic measurements for the impacts together with routine observation of penetration resistance. The force and velocity signals from the pile driving analyzer shall be calibrated before dynamic testing begins. Driving of the test pile shall continue using routine pile installation procedures with the impact hammer. The impact force applied during dynamic testing shall be applied axially and concentrically with the pile. The Contractor shall take measurements in accordance with ASTM D4945 including but not limited to recording the number of impacts for a specific penetration; record the drop of the ram or ram travel length, if applicable; for hydraulic hammers, record the kinetic energy from the hammer readout when available; record the number of blows per minute delivered by the hammer; and take, record, and display a series of force and velocity measurements. The Contractor shall compare the force and the product of velocity and impedance at the moment of impact as stated in paragraph "Quality Control" and in accordance with ASTM D4945 for data quality checks. The Contractor shall submit all pile load test data within 24 hours after completion of each test.

3.1.2 Dynamic Testing During Restrike

Restrike dynamic testing shall be performed on all test piles as shown on the drawings. The Contractor shall perform a restrike dynamic testing at 3 hours, 7 hours, and within three (3) days after completion of the corresponding static load test as shown on the plans. The number of blows per 0.1 inch for the first 2 inches and then per inch thereafter and PDA readings are to be recorded. Hammer strikes shall be terminated after 6 inches of additional pile penetration has been achieved. The Contractor shall mark the piles clearly at appropriate interval for dynamic testing. The Contractor shall attach a minimum of four strain transducers and four accelerometers to the pile(s) at a minimum distance of 1.5 pile diameters below the pile head as stated in paragraph "Placement of Transducers and Accelerometers" and in accordance with ASTM D4945. The transducers shall be securely attached to the piles by bolting. The Contractor shall connect the sensors on the pile with the pile driving analyzer located at ground level at a safe distance from the pile. The Contractor shall perform the internal calibration check and take the dynamic measurements for the impacts together with routine observation of penetration resistance. The force and velocity signals from the pile driving analyzer shall be calibrated before dynamic testing begins. The impact force applied during dynamic testing shall be applied axially and concentrically with the pile. The restrike driving sequence shall be performed with a warmed up hammer and shall consist of striking the piles until the pile penetrates an additional 3 inches. The Contractor shall take measurements in accordance with ASTM D4945 including but not limited to recording the number of impacts for a specific penetration; record the drop of the ram or ram travel length, if applicable; for hydraulic hammers, record the kinetic energy from the hammer readout when available; record the number of blows per minute delivered by the hammer; and take, record, and display a series of force and velocity measurements. The Contractor shall compare the force and the product of velocity and impedance at the moment of impact as stated in paragraph "Quality Control" and in accordance with ASTM D4945 for data quality checks.
3.2 APPLICATION

3.2.1 Impact Force Application

Impact force for the dynamic pile tests shall be made by the approved impact hammer. The hammer shall be positioned so that the impact is applied axially to the head of the pile and concentric with the pile.

3.2.2 Placement of Transducers and Accelerometers

The four transducers and four accelerometers shall be placed, diametrically opposed and on equal radial distances, at the same axial distance from the bottom or from the top of the pile so that the measurements compensate for bending of the pile. The transducers shall be attached at least 1 1/2 pile diameters from the pile head. Care shall be taken to ensure that the apparatus is securely attached to the pile so that slippage is prevented. See ASTM D4945 for typical attachment lay-outs.

3.3 DYNAMIC TESTING REPORTS

3.3.1 Test Pile Program

The Contractor's geotechnical firm shall prepare a written report of the dynamic testing program on the test piles and results. This report shall include a discussion of the pile capacity results obtained from the dynamic testing and correlation between the pile dynamic test results and the pile static test results. The report shall also discuss hammer and driving system performance, driving stress levels, pile integrity and soil characteristics such as soil damping coefficients and quake values. The written reports shall be submitted within 5 days after each set of tests is complete.

3.3.2 CAPWAP Analyses

The Contractor shall perform Case Pile Wave Analysis Program (CAPWAP) analyses of the dynamic pile testing data obtained from the "end of initial driving" and the "beginning of restrike" on all dynamically tested piles. CAPWAP analysis shall be included in the report.

3.3.3 Refined Wave Equation Analysis

The Contractor shall perform a refined wave equation analysis or analyses based upon the variations in the subsurface conditions and/or drive system performance observed in the indicator test pile program results. This analysis shall be included in the Reports. A copy of the electronic files shall also be submitted.

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STEEL H-PILES

11/01

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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor and materials, and performing all operations in connection with the installation of new steel H-piling in accordance with these specifications and applicable drawings.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


1.4  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment Description; G

Complete descriptions of pile driving equipment including rig, boom, leads, hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval prior to commencement of work.

(1) Make and model.

(2) Ram weight (pounds)

(3) Anvil weight (pounds)

(4) Weight of the moving parts of the hammer (pounds)
(5) Rated stroke (inches)
(6) Rated energy range (foot pound)
(7) Rated speed (blows per minute)
(8) Steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
(9) Power pack description

SD-02 Shop Drawings

Shop Drawings; G

Shop drawings for H-piling shall show complete dimensions and details of piling including the location of splices, and shall show the driving sequence and location of piling. Shop drawings shall include details and dimensions of templates and other temporary guide structures for installing the piling, and shall provide details of the method of handling piling to prevent permanent deflection. H-pile splice details shall be submitted to the Government Representative for review and approval.

SD-06 Test Reports

Driving Records

Records of the pile driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations.

SD-07 Certificates

Material Tests

Material test certificates shall be submitted for each shipment and identified with specific lots prior to installing piling. Identification data should include piling type, dimensions, chemical composition, mechanical properties, section properties, heat number and mill identification mark.

1.5 QUALITY CONTROL

1.5.1 General

The Contractor shall establish and maintain quality control for pile driving operations to assure compliance with contract specification and maintain records of his quality control for all construction operations including, but not limited to, the following:

(1) Driving of H-piling. The driving records shall include the pile number or identification, location, size, length, elevation of tip, cut-off and top of pile, the number of blows and ram drop (in inches) required for each foot of penetration throughout the entire length of the pile, and the number of blows per inch for the last 18 inches of penetration. The record shall include the type and size of the
hammer, the rate of operation, the type and dimensions of driving helmet, the cap-block and pile cushion used. The location and elevation of any obstruction or unusual occurrence encountered during driving shall be recorded and immediately reported to the Government Representative. The Government Representative's directed action shall also be recorded.

(2) Recording uplift and vertical tolerances after driving, pulled and redriven piles, and removal and disposal of damaged piles.

(3) Cutting and splicing of piling (welding).

(4) Plumbness of piling.

(5) Penetration depth.

(6) Stockpiling.

1.5.2 Reporting

The original and two copies of these records and tests, as well as the records of corrective action taken, shall be furnished to the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL.

1.6 QUALITY ASSURANCE

Requirements for material tests, workmanship and other measures for quality assurance shall be as specified herein and in Section 05 50 03.00 12, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. The Contractor shall provide an equipment description to ensure proper methods are being used. All steel H-piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site.

1.7 DELIVERY, STORAGE AND HANDLING

Materials delivered to the site shall be in a new and undamaged condition and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be stamped on each unspliced piling at a minimum of two locations. All piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of piling should also facilitate required inspection activities.

PART 2 PRODUCTS

2.1 MATERIALS

Steel for H-piling shall conform to the requirements of ASTM A572 Fy = 50 ksi. The H-piling shall be of the shape and sections shown on the shop drawings. Piling shall have standard square ends, unless otherwise specified or directed. Lengths of piling shall be as shown on the drawings. All steel H-piling shall be furnished full length or spliced as required if approved by the Government Representative. Painting for H-piling shall be done in accordance with paragraph "Painting".
PART 3  EXECUTION

3.1  INSTALLATION

3.1.1 Length of Permanent Piles

Pile length shall be determined using cut-off and tip elevations shown on the drawings.

3.1.2 PLACING

H-piling shall be driven as accurately as practicable in the correct locations, true to line both laterally and longitudinally and to the vertical or batter lines, all as indicated in the drawings. A lateral deviation from the correct location at the cut-off elevation of not more than 3 inches will be permitted. A variation in slope of not more than 1/4 inch per foot of longitudinal axis will be permitted. The correct relative position of group piling shall be maintained by the use of templates or by other approved means. Any H-pile driven out of correct location shall be pulled and redriven by the Contractor at no additional cost to the Government.

3.1.4 Tension Pile Connection

Welding of tension pile connections for H-piling shall preformed and tested in accordance with Section 05 50 03.00 12, "METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS". The Contractor shall ultrasonically test a minimum of 25 percent of the full penetration welds and magnetic particle test a minimum of 25 percent of the fillet welds. 100 percent of all welds shall be visually tested.

3.2  DRIVING

H-piles shall be driven by an approved steam, air or diesel drop, single acting, double-acting, or differential-acting pile driving hammer. The size and capacity of the hammer shall be as recommended by the manufacturer for the pile weights and soil formations to be penetrated. Final approval of the proposed equipment is subject to the satisfactory completion and approval of the pile load test, wave equation analysis and the engineering judgment of the Government Representative. No drilling or jetting will be allowed before or during driving operations without Government Representative's written approval. The hammer shall be operated at all times at the steam or air pressure and at the speed recommended by the manufacturer. Boiler or compressor capacity shall be sufficient to operate the hammer continuously at full rated speed. So that a single-acting hammer obtains a full upward stroke of the ram, a double-acting hammer operates at or near the blows per minute at which the hammer is rated and a differential type hammer obtains a slight rise of the base during each upward stroke. Single acting hammers shall have a scale attached (in inches) to the pile hammer and an indicator on the pile ram (see drawing at end of this section). Installation of both devices shall be in such a manner that displacement of the ram will be indicated on the scale. Both the scale and the indicator shall be easily legible to observers on the ground during operations. Hammer shall have a gage to monitor hammer bounce chamber pressure for diesel hammer or pressure at the hammer for air and steam hammers. Piling shall be protected during driving by a cushion and cap of approved design. Pile drivers shall have firmly supported leads extending to the lowest point the hammer must reach to maintain the hammer in proper alignment at all times. Each pile shall
be driven continuously and without voluntary interruption except for splicing where required until the required depth of penetration has been attained. Deviation from this procedure will be permitted only in case the driving is stopped by causes which could not reasonably have been anticipated. Where splicing of H-piling is required, the full length piling shall be cut by either an exothermic method or by any other method approved by the Government Representative. The piling shall be spliced as shown on the construction drawings. Any pile that cannot be driven to the required depth because of an obstruction shall, as directed by the Government Representative, be pulled and another pile driven adjacent thereto, be cut off and used, or be abandoned as directed by the Government Representative. The Contractor shall make observations to detect any uplift of piling already driven and uplifted piling shall be backdriven to the original penetration, at no additional cost to the Government. Piling shall not be driven within 100 feet of concrete less than 7 days old nor within 30 feet of concrete less than 28 days old. The Contractor shall provide every facility for the Government Representative to inspect and record data relative to pile driving operations. This data shall include blows and ram drop (in inches) per foot of pile penetration, final tip elevation, and blows per inch prior to seating.

3.2.1 Scale

A scale (inches) shall be fixed to the hammer's ram guide and a pointed indicator on the ram, near the scale, to allow a reading of the ram drop (see example diagram at the end of this section). Installation of both scale and indicator shall be in such a manner that the drop of the ram can be read by observing the highest and the lowest position of the indicator and scale. Both the scale and the indicator shall be easily legible to observers on the ground during operations. The Contractor shall record in the pile driving record the ram drop of the pile hammer when recording the blows per foot as specified in paragraph "DRIVING".

3.2.2 Void Backfill

Voids occurring around piles as a result of pile driving or due to any other cause and abandoned holes for piles that have been pulled, the Contractor shall pump out all seepage and rain water and backfill to within 3 feet of the adjacent ground surface with a tremie-placed slurry (from bottom to top of hole). The slurry shall consist of one part portland cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids. The upper 3 feet of the hole shall be filled with earth and compacted to the same density as the surrounding soil.

3.3 DAMAGED AND MISPLACED PILING

Any pile which is damaged because of internal defects or by improper handling or driving, or which is otherwise damaged by fault of the Contractor so as to impair it for its intended use, or any pile driven out of proper location, shall be removed and replaced. All work of removal and cost of replacement shall be borne by the Contractor at no additional expense to the Government. The Government Representative may require the Contractor to pull certain selected piling after driving for inspection to determine the condition of the piling. Any pile so pulled and found to be damaged to such extent as, in the opinion of the Government Representative, would impair its usefulness in the completed structure, shall be removed from the site of the work and the Contractor shall furnish and drive a new pile to replace the damaged pile. Piling pulled and found to be sound and
in a satisfactory condition as determined by the Government Representative shall be redriven. Any holes which remain as a result of pulling operations shall be filled as specified in paragraph "DRIVING".

3.4 Painting

The top 8-inch length of H-pile shall not be painted. Ten (10) feet of the upper portion of H-pile, beginning 8 inches down from the top of the pile, shall be painted with coal-tar epoxy in accordance with Section 09 97 02.01 12, PAINTING: COAL TAR EPOXY SYSTEM. The unpainted portion of steel H-piling which shall be embedded in concrete shall be free from surface contaminants such as oil, loose particles, or similar debris that would inhibit bonding between the concrete and piling.

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STEEL SPIRAL OR LONGITUDINALLY WELDED PIPE PILES

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PART 1  GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor, and materials required to perform all operations in connection with the installation and removal of steel spiral or longitudinally welded pipe piles in accordance with these specifications and drawings except for railroad bridges.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM A 370 (2009ae1) Standard Test Methods and Definitions for Mechanical Testing of Steel Products


AMERICAN WELDING SOCIETY (AWS)


AWS QC1 (2007) AWS Certification of Welding Inspectors

AWS D1.1 (2010; Errata 2010) Structural Welding
1.4 SUBSURFACE SOIL DATA

Subsurface soil data logs are shown on the drawings. The subsurface reports are available for examination from the Government Representative. The subsurface reports are to be used for information only and not as warranty of the subsurface conditions.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment Descriptions; G

The Contractor shall submit descriptions of pile driving equipment, delivery, storage and handling methods, placement plans, pile removal plans, driving records, quality control records, and other submittals to the Government Representative for approval as required. Submittals shall be adequately detailed to thoroughly depict intended methods or processes. Submittals not satisfactory to the Government Representative will be rejected. Complete descriptions of pile driving equipment, including hammers, power packs, extractors, leads, and other appurtenances shall comply with the requirements of paragraph "Pile Driving Equipment" and shall be submitted for approval at least 30 days prior to commencement of work.

Installation; G

Drawings shall be submitted demonstrating compliance of the driving equipment and pipe piles with the Contract documents.

Shop drawings for piles shall provide details and dimensions of all shop and field fabrications. The Contractor shall provide splice details and location. The required non-destructive testing (NDT) of welds shall be shown on the drawings.

Welding Plan; G

The welding plan for splices shall be stamped and signed by a Welding Inspector certified per AWS QC1. The welding plan shall include the qualifications for the Quality Control Inspector.
Welder Qualifications, Procedure Qualification Records (PQR) and Welding Procedure Specifications (WPS): Welder qualifications and a WPS with supporting PQR shall be submitted on any welding process utilized in the manufacturing of the pipe pile and the field splice when used. The welder qualifications, PQR and WPS shall be submitted in accordance with the requirements of AWS D1.1 Clause 4.0 and Section 05 05 23 WELDING, STRUCTURAL. The welder qualifications, PQR and WPS for each weld shall be submitted to the Government Representative and approved before fabrication is commenced. For Electronic Resistance Welding (ERW) pipe a Manufacturer's Procedure Specification (MPS) shall be submitted in lieu of the WPS and welder Qualifications. A list of the required information for the MPS is attached to the end of this section.

Welding Procedure Specifications; G

A welding procedure specification for each field weld shall be submitted to the Government Representative and approved before fabrication is commenced.

Weld Inspector Qualifications; G

For field welds the welding inspector qualifications shall be submitted for information prior to performing field welds.

Delivery, Storage, and Handling

Plans for the proposed methods of delivery, storage, and handling of piles shall comply with the requirements of paragraph "Delivery and Storage" and "Handling" and shall be submitted for review and approval at least 30 days prior to delivery of piles to the job site.

Placement; G

Placement plans shall show the proposed methods for controlling location and alignment of piles as required in paragraph "Placement" and shall be submitted for review and approval at least 30 days prior to delivery of piles to the job site.

SD-02 Shop Drawings

Shop Drawings; G

Shop drawings for piles shall provide details and dimensions of all shop and field fabrications. The Contractor shall provide splice details and location. The required non-destructive testing (NDT) of welds shall be shown on the drawings.

SD-03 Product Data

Pile Driving Equipment; G

Complete descriptions of pile driving equipment, including hammers, power packs, driving helmets, cap block, pile cushions, leads, extractors, (optional pre-boring equipment) and other appurtenances shall comply with the requirements of paragraph "Pile Driving Equipment" and shall be submitted for approval at
least 30 days prior to commencement of work. The Contractor shall submit his wave equation analysis for each proposed hammer. In addition, the following information shall be submitted for each proposed hammer:

(1) make and model
(2) ram weight (pounds)
(3) anvil weight (pounds)
(4) weight of the moving parts of the hammer (pounds)
(5) rated stroke (inches)
(6) rated energy ranger (foot-pounds)
(7) rated speed (blows per minute)
(8) steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
(9) power pack description
(10) pile driving helmet, make, and weight (pounds)
(11) pile cushion material, type, proposed cap block, including material type, dimensions, modulus of elasticity, and coefficient of restitution.

SD-06 Test Reports

Mill Test Reports; G

Certified copies of mill test reports shall be submitted for each material shipment and be identified with specific lots. Test reports shall indicate all pertinent data on strength, ductility, notch toughness, chemical analysis, heat treatment, and NDT.

Materials Test Reports; G

Certified copies of material test reports shall be submitted for all required material tests, noting the specific standards followed in the performance of tests.

Non-Destructive Testing Of Field Welds; G

The inspection and NDT shall comply with AWS D1.1, Section 6. Test results, including sketches of defects, shall be submitted within 7 days of testing.

Non-Destructive Testing of Factory Welds; G

Certified copies of all factory weld testing conducted such as visual testing (VT) and ultrasonic testing (UT), radiographic testing (RT) or magnetic particle testing (MT). Certified documents stating that testing was performed along with the type of testing (VT, UT, MT), the applicable testing standard, the applicable acceptance standards and corresponding lots designation(s) may be substituted for actual test reports. Weld inspection and NDT shall comply with AWS D1.1.

Macroetch Sampling. At the beginning of pipe fabrication, 3 representative macroetch weld samples to be furnished shall be removed from locations at the top, bottom and side of the pipe in the presence of the Government Representative and will be inspected to verify complete penetration. Samples shall indicate that the weld is free of cracks and has thorough fusion between adjacent layers of weld metal and between weld metal and base.
metal. Undercut shall not exceed 1/32 inch. Weld underfill and overlap are not permitted.

In addition to the above, all structural and welding test results shall be tabulated and submitted as one report at the end of the project. The original and two copies of these records and tests, including the records of corrective action taken, shall be furnished to the Government daily. Format of the reports shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

Driving Records

Original records of pile driving operations of each pile driven shall be submitted daily. Recorded data for piles shall include the data specified in paragraph Driving, unusual driving conditions, interruptions or delays during driving, and any other pertinent information. Indicate in the record the pile location (as driven), driven length, embedded length, final elevations of tip and top, pile weight, butt and tip diameter, number of splices and locations, blows required for each foot of penetration throughout the entire length of the pile and for the final 6 inches of penetration, and total driving time. Also include in the record the type and size of the hammer used, the rate of operation, and the type and dimensions of driving helmet, pile cushion, and cap block used. Record any unusual conditions encountered during pile installation and immediately report to the Government Representative. Record any interruptions or delays during driving, and any other pertinent information. The format for driving records shall be in accordance with the format provided by the Government Representative.

Reporting; G

The original and two copies of these records and tests, including the records of corrective action taken, shall be furnished to the Government daily. Format of the reports shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

Structural and Welding Tests; G

In addition to the above, all structural and welding test results shall be tabulated and submitted as one report at the end of the project. The original and two (2) copies of the report, including corrective action taken, shall be furnished to the Government Representative.

1.6 QUALITY CONTROL

Requirements for materials, tests, reporting, machinery, workmanship, and other measures required for quality control shall be as specified in these specifications. The Contractor shall provide continuous inspection of all operations for quality control and record the results for submission to the Government Representative in order to show compliance with the contract requirements. The Contractor's quality control records shall include but not be limited to the following items:

(1) Materials;

(2) Delivery, storage, and handling;
(3) Placing (location, alignment, etc.);
(4) Driving records;
(5) Cutting;
(6) Record keeping;
(7) Splices;
(8) Welding;
(9) Non-destructive testing of field welds;
(10) Non-destructive testing of factory welds; and
(11) Removal and storage.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery and Storage

Materials, for the test piles, delivered to the site shall be in a new and undamaged condition and shall be accompanied by certified materials test reports. The manufacturer's logo and mill identification mark shall be stamped on each unspliced pile at a minimum of two locations along with mill test reports. Delivery and storage plans shall be submitted for approval as specified in submittal paragraph "Delivery, Storage, and Handling Plans". Piles and casings shall be stacked during delivery and storage so that each pile is maintained in a straight position and is supported every 10 feet or less along its length (ends inclusive) to prevent exceeding the maximum permissible camber or sweep. Piles shall not be stacked more than 10 feet high unless approved by the Government Representative. Steel casings can be new or used but shall be in good condition.

1.7.2 Handling

The method of handling piles and casings shall be submitted for approval as required in submittal paragraph "Delivery, Storage, and Handling Plans". Piles shall be lifted using a cradle or multiple point pick-up to ensure that the maximum permissible sweep is not exceeded due to insufficient support, except that a one-point pick-up may be used for lifting piles that are not extremely long. Piles or casings shall not be dragged across the ground. The Contractor shall inspect the camber, and sweep of piles and casings for damage before transporting them from the site storage area to the driving area. Sweep shall be checked by placing piles and casings on a firm, level surface and rotating them. The maximum permissible sweep shall be 2 inches over the length of the pile. The Contractor shall, in the presence of the Government inspector, check piles and casings for damages and excessive sweep immediately prior to placement. Damaged piles or piles that do not meet the requirements as listed in paragraph "Dimensional Tolerances" will be rejected for use and replaced at no additional cost to the Government.

1.7.3 Safety

The Contractor's personnel shall not sit or place themselves on top of the
stacked piles during the handling or installation of the piling.

PART 2  PRODUCTS

2.1  MATERIALS

Pipe piles, open ended with square ends, shall be 24-inch diameter pipe piles as shown in the shop drawings. Wall thickness shall be 1/2-inch pipe piles. Pipe piles shall be steel pipe formed from plate steel seamless or with longitudinal and circumferential girth welded seams or spiral welded. Seamless pipe piles shall conform to ASTM A 252, Grade 3. Longitudinally welded pipe piles and pipe piles with circumferential girth welded seams shall conform with paragraph "LONGITUDINALLY WELDED PILES". Spiral welded pipe piles shall conform with paragraph "SPIRAL WELDED PILES".

2.1.1  Spiral Welded Piles

Spiral welded pipe piles shall conform to ASTM A 139, Grade D or E (46 ksi minimum yield stress). ASTM A 1018 coil steel (46 ksi minimum yield stress) is acceptable as a substitute base material subject to all requirements of this specification. Any API Spec 5L pipe that meets or exceeds the requirements of ASTM A 139 and does not violate any provision of this specification will be acceptable. Note that hydro-tests will not be required. The minimum specified yield strength of the spiral welded pipe pile shall be as indicated on the contract drawings. The width of the coil steel used to manufacture the spiral welded pipe piles shall not be less than 80 percent of the specified outside diameter of the pipe. Spiral welded pipe piles shall be marked with the following information; name and location of the piling producer, contract number, heat number, welding process, outside diameter, nominal wall thickness, length and the year that the piling was produced. The spiral welding process requires a WPS (Welding Procedure Specifications) and an accompanying PQR (Procedure Qualification Record) as well as qualifications for the welders and welding operators. A WPS and PQR shall also be submitted for the skelp weld splice. The butt (horizontal) splice produced in the shop shall also require a separate PQR and WPS. The welds shall be tested in accordance with AWS D1.1 Clause 6 except that the test shall extend 1 inch beyond the limits of the heat affected zone (HAZ). Testing done in accordance with AWS D1.1 shall comply with the criteria for "Statically Loaded Nontubular Connections". CVN tests of the weld HAZ shall be included in the PQR.

2.1.2  Longitudinally Welded Piles

Pipe shall be fabricated in accordance with ASTM A 139. Longitudinally welded pipe that complies with API Spec 5L and meets or exceeds Grade 46, will be an acceptable substitute. Pipe shall be marked in conformance with ASTM A 252. Hydro-tests will not be required. Except for ERW pipe, the longitudinal welding process requires a WPS and an accompanying PQR as well as qualifications for the welders/welding operators. The girth (butt) splice produced in the shop shall also require a separate PQR and WPS. The welds shall be tested in accordance with AWS D1.1 Clause 6 except that the test shall extend 1 inch beyond the limits of the heat affected zone (HAZ). Testing done in accordance with AWS D1.1 shall comply with the criteria for Statically Loaded Nontubular Connections. CVN tests of the weld HAZ shall be included in the PQR. For ERW pipe, a Manufacturing Procedure Specification shall be submitted in lieu of a WPS for the longitudinal weld. All welds (longitudinal and, if required, girth) shall be complete joint penetration welds. At girth welds,
longitudinal welds of abutting edges shall be staggered by 90 degrees and no girth welds shall be located closer together than 10 feet. A splice detail shall be submitted for approval of the Government's Representative before splicing. The butt weld may utilize a backing bar in lieu of a double side weld. Splicing shall be as specified in paragraph "Splicing".

2.1.3 Chemical Composition

The chemical composition shall meet, as a minimum, the requirements contained in ASTM A 139. The sulfur content shall not exceed 0.05 percent. The carbon equivalency shall be a maximum of 0.45 percent and shall be calculated in accordance with the supplementary requirements listed in ASTM A 1018.

2.1.4 Dimensional Tolerances

a. Out-of-Roundness: The out-of-roundness tolerance shall be within 1 percent of the nominal outside diameter.

b. Straightness: The straightness, in units of inches, shall not exceed 0.001 times the length of the pile. The length of the pile shall be measured in inches. See Appendix A, Figure 1 for additional clarification.

c. Radial Offset: A maximum radial offset of 1/8 inch shall be permitted. The offset shall be transitioned with a taper weld at the slope not less than 1 times the thickness on 2.5 times the length. See Appendix A, Figure 2 for additional clarification.

d. Weld Reinforcement (Bead Height): The weld reinforcement (bead height) shall not be greater than 3/16 inch.

e. Misalignment of Weld Beads: Misalignment of the weld beads shall not exceed 1/8 inch. This applies only to double-sided welded pipe. See Appendix A, Figure 3 for additional clarification.

f. Wall Thickness: The wall thickness shall be as indicated on the contract drawings except that up to a 10 percent greater thickness will be acceptable.

g. Outside Diameter: The outside diameter shall be as indicated on the contract drawings except that a greater diameter will be acceptable. See item f. above.

2.1.5 Corrosion Protection

Coating extents shall be as indicated on the drawings. Where the drawing indicates, the piles shall be coated to the top of the pile and where the pile is embedded in a concrete cap, the coating shall terminate at the location where the pile shaft is embedded three (3) inches into the concrete cap. Where the pile top is welded to an embed plate, the protective coating shall be removed as required to weld the pile to the plate and touch-up paint applied after completion of the welding. Painting shall be coal tar epoxy in accordance with Section 09 97 02.01 12, PAINTING: COAL TAR EPOXY SYSTEM. The unpainted portion of steel pipe piling that shall be embedded in concrete or inside a steel jacket shall be free from surface contaminants such as oil, loose particles, or similar debris that would inhibit bonding between the concrete and piling.
2.1.6 Weld Material

The weld material shall conform to the requirements in the AWS filler metal specification for carbon steel using saw process (AWS A5.17).

2.2 NON-DESTRUCTIVE TESTING OF FACTORY WELDS

Nondestructive examination shall be performed on all spiral or longitudinally welded pipe piles in accordance with AWS D1.1 Clause 6.

a. Testing Agency: The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. The laboratory and all personnel performing nondestructive testing shall be qualified in accordance with ASNT CP-189. In either case written approval of the examination procedures is required and the examination tests shall be made in the presence of the Government Representative. The evaluation of examination tests shall be subjected to the approval, and all records shall be become property of the Government.

b. Examination Procedures: Nondestructive testing shall comply with AWS D1.1 Clause 6, criteria for Statically Loaded Nontubular Connections. Specifically, visual inspection is required for 100 percent of all welds. Additionally, 25 percent of all spiral and longitudinal welds and 100 percent of all girth welds shall be tested by ultrasonic or radiographic testing for groove welds. Welds not passing the test shall be repaired and retested to assure compliance except that ERW defect sections shall be cut out and discarded. Additionally, in-line UT will be performed in-line on 100 percent of the helical weld for the purpose of identifying defects. The defect shall then be tested in accordance with AWS D1.1 Clause 6.

c. Acceptability of Welds: Welds shall be unacceptable if shown to have defects prohibited by AWS D1.1 Clause 6 for statically non-tubular connections, or possess any degree of cracks, incomplete fusion or inadequate penetration. When doubt exists as to the soundness of any material part, such part may be subjected to any form of nondestructive testing determined by the Government Representative. The costs of the investigation will be borne by the Government. Any defects will be cause for rejection and rejected parts shall be replaced and retested at the Contractor's expense.

2.3 REPAIRS

For ERW pipe only, pipes shall not be repaired. The defective section shall be cut out and discarded. Repairs shall be accomplished in accordance with AWS D1.1 paragraph 5.26. Defective weld material shall be removed by air carbon-arc or oxygen gouging to sound material. The surfaces shall be thoroughly cleaned before re-welding. When deemed necessary by the Government Representative, the Contractor shall submit a welding repair plan for approval before repairs are made. Welds that have been repaired shall be 100 percent retested by the same testing methods as used in the original inspection. Testing shall extend a minimum of 3 inches beyond the limits of the repair. All costs associated with the repairs and retesting shall be borne by the Contractor.
PART 3 EXECUTION

3.1 INSTALLATION PART I

3.1.1 Pile Driving Equipment

The Contractor shall select the proposed pile driving equipment and submit equipment descriptions of the proposed equipment for approval. Equipment approval will be based on wave equation analysis and the engineering judgment of the Government Representative. Stress predicated by wave equation analysis shall not exceed 0.80 Fy of the steel. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving system will not be allowed after the system has been approved by the Government Representative except as directed by the Government Representative. No additional contract time will be allowed for Contractor proposed changes in the approved driving system.

3.1.1.1 Pile Driving Hammers

Pile driving hammers shall be of the impact type and capable of satisfying the requirement of paragraph "Penetration Criteria". Hammers shall be steam, air, or diesel hammers of the single acting, double-acting, or differential acting type. Boiler, compressor, or engine capacity shall be sufficient to operate hammers continuously at the full rated speed so that a single-acting hammer obtains a full upward stroke of the ram, a double-acting hammer operates at or near the blows per minute at which the hammer is rated, and a differential type hammer obtains a slight rise of the hammer base during each upward stroke. Single-acting hammers shall have a scale (in inches) fixed to the hammer's ram guide and a pointed indicator fixed on the ram to allow reading of the hammer's stroke. Both the scale and indicator shall be easily legible to observers on the ground. Hammers shall have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air and steam hammers. This gage shall be operational during the driving of piles and shall be mounted in an accessible location for monitoring by the Contractor and the Government Representative. Two spare operational bounce chamber readout units shall be available on site. The Contractor shall provide bounce chamber pressure gage correction tables and charts for the type and length of hose to be used with the pressure gage to the Government Representative. The following information for each hammer proposed shall be submitted:

a. make and model
b. ram weight (pounds)
c. anvil weight (pounds)
d. weight of the moving parts of the hammer (pounds)
e. rated stroke (inches)
f. rated energy ranger (foot-pounds)
g. rated speed (blows per minute)
h. steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
i. rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch)

j. power pack description.

3.1.1.2 Pile Driving Leads or Templates

Leads shall align the pile and hammer concentrically, and maintain the pile in proper position and alignment throughout driving. Hammers shall be supported and guided with suspended leads, fixed extended leads or fixed underhung leads. The leads shall be of sufficient length to fully accommodate the combined length of the pile and hammer. Intermediate pile supports shall be provided in the leads to reduce the unbraced length of the pile during driving and pulling. The Contractor shall laterally support the pile during driving. At least one intermediate support of the pile in the template is required to reduce the unbraced length of the pile during driving.

3.1.1.3 Driving Helmets and Pile Cushions

A driving helmet including a pile cushion shall be used between the top of the pile and the ram to prevent impact damage to the pile. The driving helmet and pile cushion combination shall be capable of protecting the head of the pile, minimize energy absorption and dissipation, transmit hammer energy uniformly over the top of the pile during driving. The driving helmet shall fit loosely around the top of the pile so that the pile is not restrained by the helmet if the pile tends to rotate during driving. The pile cushion may be of solid wood or of laminated construction, completely cover the top surface of the pile, and be retained by the driving helmet. Minimum thickness of the pile cushion shall be (3 inches) and the thickness shall be increased so as to be suitable for the size and length of pile, character of subsurface material to be encountered, hammer characteristics, and the required driving resistance. The following information for each hammer proposed shall be submitted:

(1) pile driving helmet, make, and weight (pounds).

(2) pile cushion material, type, proposed thickness, modulus of elasticity, and coefficient of restitution.

3.1.1.4 Cap Blocks

The cap block (hammer cushion) used between the driving cap and the hammer ram may be of solid hardwood block with grain parallel to the pile axis and enclosed in a close-fitting steel housing or may consist of aluminum and approved industrial type plastic laminate disks stacked alternately in a steel housing. Steel plates shall be used at the top and the bottom of the cap block. The cap block shall be replaced if it has been damaged, highly compressed, charred, or burned or has become spongy or deteriorated in any manner. If a wood cap block is used, it shall not be replaced during the final driving of any pile. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy be permitted.
3.1.1.5 Pile Extractors

Pile extractors may be vibratory and/or impact pile driving hammers. Impact hammers are required for pulling piles not extractable with vibratory hammers. For the use of the vibratory hammer, weight indicator shall be attached to the crane during extraction.

3.1.2 Pile Follower

A follower will be allowed to reach the correct pile top elevation when either driving in water or when driving below ground surface. If a follower is used, the wave equation analysis should include the follower.

3.2 INSTALLATION PART II

3.2.1 Lengths of Piles

The lengths of piles shall be as shown in the drawings.

3.2.2 Placement and Tolerances

A pile placement plan shall be developed to show the installation sequence and the methods proposed for controlling the location and alignment of piles and submitted for approval. Piles shall be placed accurately in the correct location and alignments, both laterally and longitudinally, and to the vertical or batter lines indicated. The Contractor shall establish a permanent baseline during pile driving operations to provide for inspection of pile placement by the Government Representative. The baseline shall be established prior to driving permanent piles and shall be maintained during the installation of the permanent piles. Prior to driving and with the pile head seated in the hammer, the Contractor shall check each pile for correct alignment. The alignment of battered piles shall be checked and monitored during driving with an accurate batter board level and surveying instrument. A final lateral deviation from the correct location at the cutoff elevation or top of pile elevation of not more than 3 inches will be permitted. A vertical deviation from the correct cutoff elevations or top of pile elevation shown on the drawing of not more than 1 inch will be permitted. A final variation in slope of not more than 1/4 inch per foot of longitudinal axis will be permitted. The correct relative position of all piles shall be maintained by the use of templates or by other approved means. Piles not located properly or exceeding the maximum limits for lateral deviation, and/or variation in alignment shall be pulled and redriven at a directed location.

3.2.3 Pile Driving

Piles shall not be driven within 100 feet of concrete less than 7 days old nor within 30 feet of concrete less than 28 days old unless otherwise authorized. The sequence of installation shall be such that pile heave is minimized. The Government Representative shall be notified 30 days prior to the date driving is to begin.

3.2.3.1 Driving Records

The Contractor shall develop a form for recording the pile driving operations, obtain approval of this form, and compile complete records of the operations. Pile driving records shall include pile dimensions and location, pile identification number, casting date, date driven, original pile length, cutoff and tip elevations, batter alignment, description of
hammer used, rated hammer energy, observed stroke and rate of hammer operation (blows per minute), air or steam pressure at the hammer or bounce chamber pressure, length of pressure hose, penetration under the combined weight of the pile and hammer, number of blows required for each foot of penetration throughout the entire length of each pile and for each inch of penetration in the last foot of penetration, time for start and finish of driving, total driving time in minutes and seconds for each pile, cushion information including changes during driving, and any other information as required or requested. Record shall also include information such as unusual driving conditions, interruptions or delays during driving, observed pile damage, heave detected in adjacent piles, records of restriking, depth and description of voids formed adjacent to the pile, and any other pertinent information may be required at the direction of the Government Representative.

3.2.3.2 Penetration Criteria

Piles shall be driven to the required depth of penetration shown in the drawings.

3.2.3.3 Driving

Permanent piles shall be driven with hammers of the same model and manufacturer, same energy and efficiency, and using the same driving system. The hammer shall be operated at all times at the speed and under the conditions recommended by the manufacturer subject to the approval of the Government Representative. Once pile driving has begun, conditions such as alignment and batter shall be kept constant. Each pile shall be driven continuously and without interruption until the required depth of penetration has been attained. Deviation from this procedure will be permitted only for necessary changes to the pile cushion or whenever driving is stopped by causes that reasonably could not have been anticipated. Pile cushion changes will be considered necessary whenever the cushion has become highly compressed, charred, burned, or deteriorated. Changes to the cushion will not be allowed near the end of driving. A pile that cannot be driven to the required depth because of an obstruction, as indicated by a sudden unexplained change in blow count and drifting, shall be pulled and redriven or shall be cut off and abandoned, whichever is directed by the Government Representative.

a. Scale - A scale (in inches) shall be fixed to the hammer's ram guide and a pointed indicator on the ram, near the scale, to allow a reading of the ram drop. Installation of both scale and indicator shall be in such a manner that the drop of the ram can be read by observing the highest and the lowest position of the indicator and scale. Both the scale and the indicator shall be easily legible to observers on the ground during operations. The Contractor shall record in the pile driving record the ram drop of the pile hammer when recording the blows per foot as specified in paragraph "Driving".

3.2.3.4 Heaved Piles

When driving piles in clusters or under conditions of relatively close spacing, observations shall be made to detect heave of adjacent piles. Heaved piles shall be restripped sufficiently to relieve soil setup and driven to the original penetration criteria.
3.2.3.5 Pulled Piles (Damaged and Misplaced Piles)

Piles damaged or impaired for use during driving shall be pulled and replaced with new piles, or shall be cut off and abandoned and new piles driven as directed. The Government Representative may require that any pile be pulled for inspection. Piles pulled at the direction of the Government Representative and found to be in suitable condition shall be redriven at a directed location. Any pile which is damaged because of internal defects or by improper handling or driving, or which is otherwise damaged by fault of the Contractor so as to impair it for its intended use, or any pile driven out of proper location, shall be removed and replaced. All work of removal and cost of replacement shall be borne by the Contractor at no additional expense to the Government. The Government Representative may require the Contractor to pull certain selected piling after driving for inspection to determine the condition of the piling. Any pile so pulled and found to be damaged to such extent as, in the opinion of the Government Representative, would impair its usefulness in the completed structure, shall be removed from the site of the work and the Contractor shall furnish and drive a new pile to replace the damaged pile. Piling pulled and found to be sound and in a satisfactory condition as determined by the Government Representative's Representative shall be redriven. Any holes which remain as a result of pulling operations shall be filled as specified in paragraph "DRIVING".

3.2.3.6 Jetting

Jetting of piles will not be permitted.

3.2.3.7 Preboring

Preboring will not be allowed.

3.2.3.8 Cutting of Piles

The proposed method for cutting of piles must be approved and shall not damage the pile. The use of explosives will not be permitted. Cut off sections of piles shall be removed from the site upon completion of the work.

3.2.3.9 Splicing

The Contractor shall submit a welding plan, welding procedure specifications, and weld inspector qualifications for approval. Splices may be used after the splice details and methods have been reviewed and approved by the Government Representative. Note that prefabricated and mechanical splices will not be allowed. No more than two splices per full length of pile will be permitted. All splices shall be complete joint penetration welds. No splice will be permitted within the upper third of the pile or in the portion of the pile within 5 feet of maximum tensile stress as located in the pile and shown on the contract drawings. If circumstances dictate that this requirement be violated, then the locations of the splice and details of the splice shall be submitted to the Government Representative for approval. The splices shall be able to develop 100 percent of the pile structural capacity. Lateral joints shall be made with a continuous full penetration butt weld in accordance with AWS D1.1. Backer rings will be allowed provided the meet the following criteria:

a. They shall be a minimum of 3/8 inch thick.
b. Splicing in the backer rings shall be made by full penetration welds.

c. Attachment of the rings to the pipe shall be done by using the minimum size and spacing of tack welds that will securely hold the backing ring in place.

d. Tack welding shall be done in the root area of the weld splice.

e. The gap between the backing ring and the pipe wall shall be no greater than 5/64 inch.

Unless reduced by an approved WPS, the minimum preheat and interpass temperature for splice welding and for making repairs shall be 150 degrees F regardless of the pipe wall thickness. In the event welding is disrupted, preheating to 150 degrees F must occur before welding is resumed. Welds shall not be water quenched but allowed to cool unassisted to ambient temperature.

3.3 STRUCTURAL AND WELDING TESTS

Favorable results for these tests are required before driving of piles can commence:

(1) CVN Impact Test: Charpy V Notch (CVN) testing shall be conducted in accordance with ASTM A 370. A CVN impact test shall be conducted on the base metal once per heat and shall be conducted on the weld metal once per 50 piles. A minimum average absorbed energy of 20 foot-pounds and the minimum individual value of 15 foot-pounds shall be obtained at 0 degrees F. Tests shall be conducted for each different pipe pile section.

(2) Macroetch Testing.

   (a) Macroetch Sampling: At the beginning of pipe fabrication, 3 representative macroetch weld samples to be furnished shall be removed from locations at the top, bottom and side of the pipe in the presence of the Government Representative and will be inspected to verify complete penetration. Samples shall indicate that the weld is free of cracks and has thorough fusion between adjacent layers of weld metal and between weld metal and base metal. Undercut shall not exceed 1/32 inch. Weld underfill and overlap are not permitted.

   (b) Results of Macroetch Test: The weld specimens shall be prepared with a finish suitable for macroetch examination. A suitable solution shall be used for etching to give a clear definition of the weld. The weld shall have complete joint penetration, thorough fusion between weld metal and base metal, no cracks and no undercut exceeding 1/32 inch.

(3) Results of Selected Test Coupons.

3.4 TESTING OF MECHANICAL PROPERTIES

Favorable results of these tests are required before the driving of piles can commence.
3.4.1 Tensile Tests

3.4.1.1 Tensile Testing Specimens

Tensile test orientation shall be relative to the pile. At the option of the manufacturer, the specimen may be either full section, strip specimen or round bar specimen.

3.4.1.2 Tensile Testing Frequency

One tensile test shall be made per 50 piles.

3.4.1.3 Longitudinal Tensile Test

At the option of the manufacturer, longitudinal test may utilize a full specimen. The strip specimen shall be tested without flattening.

3.4.1.4 Transverse Tensile Tests

The transverse tensile properties shall be determined as follows: The yield strength, ultimate strength and elongation values shall be determined on a flattened rectangular specimen. The same method of testing shall be employed for all lots for a given pile diameter and wall thickness. All specimens shall represent the full wall thickness of the pipe from which the specimen was cut.

3.4.1.5 Weld Tensile (Reduced Section Tension) Tests

The weld tensile test specimens shall be taken at 45 degrees to the weld with the weld at the center, and shall represent the full wall thickness of the pipe from which the specimen was cut. Weld reinforcement shall not be removed unless directed by the Government Representative.

3.4.2 Flattening Tests

Flattening test shall be performed as directed.

3.4.3 Guided - Bend Test

The test specimens shall be taken from the longitudinally welded pipe of each combination of outside diameter and wall thickness containing skelp weld ends. The specimens shall not contain repair welds. Test shall be in accordance with API Spec 5L or AWS D1.1, Clause 4. One test per 50 piles.

3.5 VOID BACKFILL

Voids occurring around piles as a result of pile driving or due to any other cause and abandoned holes for piles that have been pulled shall be filled to within 3 feet of the adjacent ground surface with a tremie-placed slurry (from bottom to top of hole). The slurry shall consist of one part portland cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids. The upper 3 feet of the hole shall be filled with earth and compacted to the same density as the surrounding soil.

-- End of Section --
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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, equipment labor, and materials, and performing all operations in connection with performing surveys, and the installation of round untreated timber piles in accordance with these specifications and as shown on the drawings.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 QUALITY CONTROL

1.3.1 General

The Contractor shall establish and maintain quality control for driving, timber piles to assure compliance with contract specifications and maintain records for his quality control for all construction operations including, but not limited to the following:

(1) Wood species and grade.

(2) Accurate pile placement, driving and alignment of piling.

(3) Driving record. The record shall include the pile number or identification, location, size, length, elevation of tip, cut off top of pile, the number of blows and ram drop (in inches) required for each foot of penetration throughout the entire length of the pile, and the number of blows per inch for the last 18 inches of penetration, predrilling depth, size of predrilling, and type of predrilling. The record shall include the type and size of the hammer, the cap block and pile cushion used. The location and elevation of any obstruction or unusual occurrence encountered during construction shall also be recorded.

(4) Recording uplift and vertical tolerances after driving; pulled and redriven piles; and removal and disposal of damaged piles.

(5) The electronic files from the Pile Driving monitor for all piles driven with a diesel hammer.

1.3.2 Reporting

The original and two copies of these records and tests, as well as corrective action taken, shall be furnished the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.
1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 25 (1999; R 2005) Round Timber Piles

SOUTHERN PINE INSPECTION BUREAU (SPIB)


U.S. DEPARTMENT OF COMMERCE (DOC)


1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pile placement Plans; G

Pile placement plans shall be submitted to the Government Representative for approval.

SD-03 Product Data

Equipment Descriptions; G,

Equipment Descriptions of all pile driving equipment to be employed in the work shall be submitted for approval prior to commencement of pile installations. This shall include details of the pile hammer, power plant, leads, cushion material, and helmet.

SD-06 Test Reports

Driving Record

A record of the driving of piles containing information as required in paragraph "General" shall be an electronic copy submitted to the Government Representative daily and a weekly summary report of all timber pile driving.

Electronic Files from Pile Driving Motor

The electronic files from Pile Driving Motor utilized in the driving of permanent piles installed with a diesel hammer as required in the paragraph entitled "General" shall be submitted to the Government Representative daily.
1.6 HANDLING OF PILES

Special care shall be taken in supporting piles to prevent the inducing of excessive bending stresses. Piles shall be carefully handled without dropping or breaking of outer fibers or penetrating the surface with tools. Peaveys, cant hooks, pikes, and other pointed tools shall not be used in handling timber piles.

PART 2 PRODUCTS

2.1 TIMBER PILES

2.1.1 Material

Piles shall conform to ASTM D 25, Class A and B Douglas fir or Southern pine (where indicated on the drawings), clean peeled untreated, 38 inch minimum butt circumference (measured 3 feet from the butt) (13-inch diameter) and a minimum tip diameter of 8 1/2-inch, single length, and other requirements as shown on the drawings and /or specified in specifications. Contractor shall also refer to SPIB 1003 and PS20 for standards regarding southern pine or softwood lumber.

2.1.2 Pile Lengths

Pile length and tip elevations are shown on the drawings.

2.1.3 Probe and Test Piles

Probe and test pile lengths shall be determined by the Contractor based on tip elevations shown on the Drawings. Each pile shall be round and have a maximum tip diameter of 8 1/2 inches. Further, the Contractor shall ensure the diameter of the driven test pile at an elevation corresponding to the permanent pile cut-off elevation does not vary appreciably from the minimum butt diameter of 13 inches.

PART 3 EXECUTION

3.1 Pile Driving Equipment

3.1.1 Pile Driving Hammers

The pile driver to be used for this work shall be of sufficient design to handle loads imposed upon it under the extreme conditions anticipated without danger of tipping, overturning or structural and/or mechanical failure. Hammers shall be air single-type, or diesel. The diesel hammer shall be equipped with a Pile Driving Monitor and Energy Control System capable of controlling the hammer energy so the maximum allowable energy is not surpassed. The Pile Driving Monitor shall also be capable of providing an electronic readout of the energy utilized by the diesel hammer. The size or capacity of hammers shall be as recommended by the manufacturer for the pile weights and soil formation to be penetrated. Equipment descriptions shall be submitted to the Government for review. The maximum driving energy of hammers shall be 15,000 foot pounds for piles of any length.

3.1.2 Pile Driving Leads

Leads shall align the pile and hammer concentrically, and maintain the pile in proper position and alignment throughout driving. Hammers shall
be supported and guided with fixed extended leads or fixed underhung leads. The leads shall be of sufficient length to fully accommodate the combined length of the pile and hammer.

3.1.3 Reserved

3.1.4 Driving Cap and Cap Block

A driving cap of an approved design and capable of protecting pile heads, minimizing energy absorption and transmitting hammer energy uniformly and consistently to piles shall be used. The driving cap shall fit snugly on the top of piles and shall employ a cushion block to prevent impact damage to piles. The cap block may be a solid block with the grain parallel to the pile axis and enclosed in a close fitting steel housing. The thickness of the block shall be suitable for the length of pile to be driven and the character of subsurface material to be encountered.

3.1.5 Pile Collars

Collars of bands for protecting pile butts against splitting, brooming and other damage while being driven shall be of an approved design.

3.2 Piles

3.2.1 Driving

A complete and accurate record of the driven piles shall be compiled by the Contractor for submission to the Government Representative. Additionally, for all diesel hammers, the electronic files from the Pile Driving Monitor shall be submitted to the Government Representative, daily. This record shall include the information indicated in subparagraph "General". During driving, hammers shall be operated at all times at the rate and conditions recommended by the hammer manufacturer. Each pile shall be driven continuously and without interruption until the required depth of penetration has been attained. Deviation from this procedure will be permitted only when driving is stopped by causes which could not have been reasonably anticipated. The blow counts shall not exceed the maximum blow count recommended from the pile load test results or 60 blows per foot (or 5 blows per inch). Piles shall be driven to the full penetration required where practical to do so without damage to the piles. If found impractical to drive any pile to the depth required, such pile shall be cut off and abandoned or pulled as directed by the Government Representative. Driving piles beyond the point of refusal, as indicated by excessive bouncing of the hammer or kicking of the pile, shall not be attempted. The Contractor may have to reduce the amount of energy per blow used to drive piles based on recommendation of the testing lab when vibration readings exceed velocities of 0.25 in/sec. to avoid damage to the surrounding buildings. Piles which have uplifted after driving shall be backdriven to grade after a conclusion of driving in that general area. After driving is completed, all piles shall be "headed", or cut off, as required for the pile load test. Cut offs shall become the property of the Contractor and shall be removed and disposed of at his expense. Voids occurring around piles as a result of pile driving or due to any other cause and abandoned holes for piles that have been pulled shall be filled to within 3 feet of the adjacent ground surface with a tremie-placed slurry (from bottom to top of hole). The slurry shall consist of one part portland cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids. The upper 3 feet of the hole shall be filled.
with earth and compacted to the same density as the surrounding soil.

3.2.2 Scale

A scale (inches) shall be fixed to the single-acting hammer's ram guide and a pointed indicator on the ram, near the scale, to allow a reading of the ram drop (see diagram at the end of this section). Installation of both scale and indicator shall be in such a manner that the drop of the ram can be read by observing the highest and the lowest position of the indicator and scale. Both the scale and the indicator shall be easily legible to observers on the ground driving operations. The Contractor shall record the ram drop of the pile hammer when recording the blows per foot as specified in paragraph "TIMBER PILES".

3.2.3 Jetting

Jetting shall not be used to assist driving the piles.

3.2.4 Predrilling

Predrilling shall be used to assist installation through the underlying sand strata and to reduce vibrations. Predrilling shall be performed by wet rotary methods. Predrill diameter of no greater than six (6) inches may be used. Predrilling shall be performed to a maximum depth of 5 feet below grade to assist installation through the underlying sand strata. The actual predrill depth will be verified by the test pile program.

3.2.5 Damaged Piles

Piles damaged as a result of internal defects or improper driving below the cutoff elevations so as to impair them for their intended use, shall be removed and replaced. All work of removal and cost of replacement shall be borne by the Contractor at no additional expense to the Government. The Government Representative may require the Contractor to pull certain selected piles after driving for inspection to determine the condition of the piles. Any pile so pulled and found to be damaged to such extent as, in the opinion of the Government Representative, would impair its usefulness in the completed structure, shall be removed from the site of the work and the Contractor shall furnish and drive a new pile to replace the damaged pile at no additional cost to the Government. Piles pulled and found to be sound and in a satisfactory condition as determined by the the Government Representative shall be redriven and will be paid for in accordance with applicable item as specified in Section 01 22 00.00 10 MEASUREMENT AND PAYMENT. Any holes which remain as a result of pulling operations shall be filled.

-- End of Section --
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PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, materials, testing, and equipment required for constructing superpave asphaltic pavement as specified herein and as shown on the drawings.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)

ASTM D2216 (2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D2922 (2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES (2006 Edition), LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT (LADOTD)

LSSRB 301 Class I Base Course
LSSRB 501 Asphaltic Concrete Mixtures
LSSRB 502 Superpave Asphaltic Concrete Mixtures
LSSRB 503 Asphaltic Concrete Equipment and Process
LSSRB 504 Asphaltic Tack Coat
LSSRB 505 Asphaltic Prime Coat
LSSRB 1002 Asphaltic Materials
1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control for excavation, compacting and paving operations to assure compliance with contract requirements and maintain records of his quality control for all construction operations including but not limited to the following:

(1) Check grades where applicable. All lines and grades will be established by the Contractor and shall be maintained by means of grade stakes placed in lanes parallel to the centerline of the areas to be paved, and spaced so that string lines may be stretched between the stakes.

(2) Check width and thickness of all courses.

(3) Check for proper compaction.

(4) Check asphalt mix and aggregate materials and job mix for compliance with contract requirements; and inspect the plant mixes and perform specified field tests in accordance with contract requirements.

(5) Check prepared surfaces prior to applying paving materials.

(6) Check coverage rate of application of paving materials.

(7) Check application of striping material for compliance with applicable specifications.

(8) Check installation of traffic signs.

1.4.2 Smoothness Tests

The finished surface shall not vary more than 1/8 inch for surface courses and 1/4 inch for base and binder courses when tested with a 10-foot straightedge applied both parallel with and at right angles to the centerline of the paved area. After the completion of the final rolling
the smoothness of the course shall be checked, and the irregularities that exceed the specified tolerances or that retain water on the surface shall be corrected by removing the defective work and replacing with new material, at no additional cost to the Government.

1.4.3 Reporting

The original and two (2) copies of these records and tests, as well as the records of corrective action taken shall be furnished to the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.5 INSPECTION AND TESTING

1.5.1 Asphalt

Samples and testing will be handled at the Contractor's expense by an independent testing laboratory acceptable to the Government Representative. Inspection and testing services will be required for design and control of plant mixes (using Marshall method) and field density in order to determine compliance with specified provisions herein.

1.5.1.1 Testing for Quality Control

At least one series of plant tests shall be conducted on every fifty tons or fraction thereof of asphalt run, or each day's run of lesser amount. Each series of tests shall consist of Marshall Stability and Flow (according to TPM TR 305) and Percent Voids (percent Voids) and Percent Voids Filled with Asphalt (percent VFA) (according to TPM TR 304), performed on 4 different samples. Briquettes shall be molded to be used in density tests computations. The results of these tests shall conform with the requirements of Table 501-3 in LSSRB 501 for Type 3 mixes. The results shall be submitted to the Government Representative. In the event that the results show deviations from the standards, the Contractor shall be responsible for the necessary adjustments.

1.5.1.2 Testing for Acceptance

Upon completion of compaction, pavement samples shall be obtained within the area represented by that run, in accordance with LSSRB 501.09. The density requirements for the average of the two samples will be as shown in Table 501-3 of LSSRB 501, as determined in accordance with TPM TR 304. Acceptance requirements and testing shall be in accordance with LSSRB 501.10, LSSRB 501.11, and LSSRB 501.12, unless otherwise specified, except for statements about payment and payment adjustments.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Asphaltic Concrete Mixtures; G

Asphaltic concrete mixes shall be submitted for approval to the
Government Representative before paving operations begin. The submitted job mix formula shall be in accordance with LSSRB 501.03(b).

SD-07 Certificates

Asphaltic Prime Coat

Certification that the prime coat material meets the requirements of paragraph "ASPHALTIC PRIME COAT".

Asphaltic Tack Coat

Certification that the tack coat material meets the requirements of paragraph "ASPHALTIC TACK COAT".

Asphalt Cement

Certification that the asphalt cement meets the requirements of paragraph "ASPHALT CEMENT".

PART 2 PRODUCTS

2.1 SUBBASE MATERIAL

The subbase material shall be sand fill. Sand fill should be non-plastic and free of roots, clay lumps and other deleterious materials with no more than 10 percent by weight of material passing a U.S. Standard No. 200 mesh sieve.

2.2 BASE MATERIAL

The base material shall be Stone and shall conform to the requirements of LSSRB 1003.01 and LSSRB 1003.03.

2.3 SURFACE MATERIAL

2.3.1 Asphaltic Prime Coat

The asphaltic prime coat shall be cutback asphalt Grade MC-30, MC-70 or AEP Emulsified Asphalt conforming to LSSRB 1002.

2.3.2 Asphaltic Tack Coat

The asphaltic tack coat shall be an undiluted modified asphalt emulsion Grade CRS-2P, CSS-1, SS-1, SS-1P or SS-1L conforming to LSSRB 1002.

2.3.3 Asphaltic Concrete Pavement

The asphaltic concrete binder course mix shall be Type 8 and wearing course mixes shall be Type 8 and the base course shall be Type 5 all meeting the requirements of LSSRB 502 unless otherwise specified herein. The asphaltic concrete mixes shall be designed and tested according to LSSRB 502 and the determination of the optimum asphalt cement content shall be according to TPM TR 303, method A or B.

2.3.3.1 Aggregates

Aggregates shall meet the requirements of LSSRB 502 and LSSRB 1003.
2.3.3.2 Asphalt Cement

Asphalt Cement shall be the grade specified in LSSRB 502 for the specified mixture type and shall conform to the requirements of LSSRB 1002.

PART 3 EXECUTION

3.1 SIGNS AND BARRICADES

The Contractor shall furnish, install, and maintain all necessary barricades, warning signs, danger signals, speed regulatory signs, directional signs and all other traffic devices as specified in Section 01 55 26.00 12 TRAFFIC CONTROL AND COORDINATION.

3.2 ASPHALT PAVING BASE

3.2.1 Subbase

The asphalt paving subbase shall be furnished and placed as shown on the drawings and as specified herein. Sand fill for the subbase shall be compacted to 98 percent of the maximum dry density at optimum water content in accordance with ASTM D1557. In place density shall be determined in accordance with ASTM D1556 or ASTM D2922 and water content shall be determined in accordance with ASTM D2216.

3.2.2 Base Course

The asphalt paving base course shall be furnished and placed as shown in the drawings, and in accordance with LSSRB 301.

3.2.3 Asphalitic Prime Coat

An asphalitic prime coat shall be applied in accordance with LSSRB 505 between the subbase and asphalt base.

3.2.4 Asphalitic Tack Coats

An asphalitic tack coat shall be applied in accordance with LSSRB 504 before constructing each course.

3.3 PREPARATION FOR ASPHALT PAVING

The surface to be covered shall be approved by the Government Representative prior to placing mixtures. The Contractor shall maintain the surface until it is covered. The surface to be covered shall be swept clean of dust, dirt, caked clay, caked material, and loose material by revolving brooms or other mechanical sweepers supplemented with hand equipment as directed. When brooming does not adequately clean the surface, the Contractor shall wash the surface with water. When liquid asphalt is exposed to traffic for more than 2 calendar days, becomes contaminated, or degrades, the liquid asphalt shall be reapplied at the initial recommended rate at no expense to the Government. Paving operations shall proceed only when the subgrade or base course is dry and the atmospheric temperature in the shade and away from artificial heat is above 40 degrees F and rising.
3.4 ASPHALT PAVING

3.4.1 Asphalt Job Mix Formula

Design and quality control of mixtures shall be in accordance with LSSRB 50 2.03.

3.4.2 Asphalt Road Equipment

All equipment, tools and machines used in the performance of work covered by this section including the plants furnishing asphaltic concrete mixtures shall be in accordance with LSSRB 503 and subject to the approval of the Government Representative.

3.5 ASPHALT MIX

3.5.1 Asphaltic Mix

The asphaltic concrete mixtures shall be produced in an approved plant as specified in LSSRB 503.

3.5.2 Preparation of Mineral Aggregates

In all cases the fine and coarse aggregate shall be piled separately, but may be fed to the drier by a common mechanical feeder. The aggregates shall be heated and thoroughly dried, then screened and stored in separate bins ready for mixing with the bituminous material. Adequate dry storage shall be provided for mineral filler.

3.5.3 Preparation of Asphalt Mixture

The aggregates, prepared as specified hereinbefore, and dry mineral filler shall be accurately weighed or measured and conveyed into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. The required amount of asphalt for each batch shall then be introduced into the mixer. In batch mixing, after the aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, the bituminous material shall be added and mixing continued for a period of not less than 20 seconds and as much longer as may be required to obtain a homogeneous mixture. When a continuous mixer is employed, the mixing time shall be not less than 35 seconds and as much longer as may be required to obtain a homogeneous mixture. The additional mixing time, when required, shall be determined by the Government Representative. In no case shall the aggregate be introduced into a mixture at a temperature more than 25 degrees F above the temperature of the asphalt. The temperature of the bituminous material at the time of mixing shall not exceed 325 degrees F. The temperature of the aggregate and mineral filler in the mixer shall not exceed 350 degrees F. When the mixture is prepared in twin pugmill mixer, the volume of the aggregates, mineral filler, and bituminous material shall not be so great so as to extend above the tops of the mixer blades when the blades are in a vertical position. All overheated and carbonized mixtures which foam or show indication of moisture, will be rejected by the Government Representative. When moisture is detected in the finished mixture, all aggregates in the bins shall be removed and placed in their respective stockpiles.
3.6 TRANSPORTATION

Transportation of asphaltic mixture from the mixing plant to the site shall be in accordance with LSSRB 502.07. Mixtures shall be transported from the plant and delivered to the paver at a temperature no cooler than 25 degrees F below the lower limit of the approved job mix formula. The temperature of the mix going through the paver shall not be cooler than 250 degrees F. Hauling over freshly laid material will not be permitted.

3.7 PLACEMENT AND COMPACTION

3.7.1 Placement

The asphaltic concrete pavement shall consist of 2 inches of wearing surface, and 2 inches of binder course. The binder course shall be provided as needed to bring the road surface at required elevation. Placing of asphaltic mixtures shall be in accordance with the specified lift thicknesses and in accordance with LSSRB 502.07.

3.7.2 Compaction

Compaction of mixtures shall be in accordance with LSSRB 501.08.

3.7.3 Joints

Longitudinal joints and transverse joints shall be made in accordance with LSSRB 502.07(c).

3.7.4 Protection

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened, and in no case less than 6 hours.

-- End of Section --
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SURFACING (GRANULAR)

04/08

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor and materials and performing all work necessary to construct and maintain surfacing for the levee crown, ramps, and new access roads as indicated on the drawings, as well as temporary detour roads and access ramps.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
Sur

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be
submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing; G

Certified LA abrasion, Atterberg limits, soundness and gradation test results of surfacing material shall be submitted to the Government Representative for approval prior to shipment.

1.5 1.6 QUALITY CONTROL

1.5.1 General

The Contractor shall establish and maintain quality control for the surfacing operations to assure compliance with contract specifications and maintain records of his quality control for all construction operations including but not limited to compliance with surfacing standards, quality and gradation of surfacing, thickness of surfacing prior to compaction, and width and location of the roadway in relation to the new levee centerline and levee crown.

1.5.2 Sampling and Testing

All laboratory facilities, personnel, and equipment used to test shall be part of a validated laboratory that has been approved by the Government.

1.5.2.1 Sampling

Sampling of material shall be performed in conformance with ASTM D75. Sampling will be observed by the Government Representative.

1.5.2.2 Testing

Testing of surfacing materials shall be performed at a minimum frequency of one set of tests per 2500 cubic yards or fraction thereof of surfacing material placed. Testing of surfacing materials shall include gradation and Atterberg limit testing as indicated in paragraph(s) "Crushed Stone". Test performance shall be pursued in such a manner that the results are obtained in the minimum time frame. All test results shall be furnished to the Government Representative to confirm materials' compliance with the specifications. Surfacing materials not meeting the specifications shall be removed from the site and replaced with surfacing materials meeting the specifications.

1.5.3 Reporting

The original and two copies of these records, as well as the records of corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

PART 2 PRODUCTS

2.1 SURFACING

Surfacing material shall be:
2.1.1 Crushed Stone

Crushed stone shall be obtained from a Government approved source and shall consist of 100 percent stone and shall meet the following requirements when tested in accordance with ASTM C136 and ASTM C117, Procedure B:

<table>
<thead>
<tr>
<th>U.S. Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2-inch</td>
<td>100</td>
</tr>
<tr>
<td>3/4-inch</td>
<td>50 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>35 - 65</td>
</tr>
<tr>
<td>No. 40</td>
<td>10 - 32</td>
</tr>
<tr>
<td>No. 200</td>
<td>3 - 15</td>
</tr>
</tbody>
</table>

The fraction of material passing the No. 40 sieve shall conform to the following requirements when tested in accordance with ASTM D4318:

- Liquid Limit (Max.) 25
- Plasticity Index (Max.) 4

Crushed stone shall show an abrasion loss of not more than 40 percent when tested in accordance with ASTM C131 and a soundness loss of not more than 15 percent when subjected to 5 cycles of the magnesium sulfate soundness test in accordance with ASTM C88.

PART 3 EXECUTION

3.1 BASE PREPARATION

Prior to placement of the surfacing as indicated on the drawings, all debris shall be removed from the area to receive the surfacing. Base preparation for the entire levee crown ramps and access roads, shall be completed in advance of placing surfacing.

3.2 PLACEMENT AND COMPACTION

The placement of surfacing shall not commence until all slope operations in the area have been finalized, including final dressing of the levee crown. No surfacing shall be placed or compacted on a muddy or rutted subgrade. The surfacing material shall be compacted to provide a smooth, uniform, closely-knit riding surface free from ridges and depressions. Compaction shall be performed by making two or more passes with a rubber-tired roller. The surfaced area shall have 6-inches and 8-inches of crushed stone as indicated on the plans. Any damage to the finished surfacing by the Contractor's construction operations shall be repaired by the Contractor at no expense to the Government.

3.2.1 Shaping

The surface course shall be shaped by the use of a blade grader or other suitable means. Any ruts formed shall be shaped as often as necessary to prevent breaking through the surfacing material into the subgrade or into the geotextile fabric. Holes, waves, and deficiencies in thickness, which may develop and are not filled by shaping, shall be filled by adding more material. Shaping shall continue until the surface is free from ruts, waves, and undulations.
3.2.2 Rollers

The minimum requirements for rubber-tired rollers to be used for compaction will be a 10-ton, 11-wheel, 7.50 x 15 tires, towed type, tandem pneumatic-tired roller. All rollers shall be towed at speeds not to exceed 5 miles per hour.

3.3 MAINTENANCE

3.3.1 Temporary Detour and Access Ramps

The temporary detour and access ramps shall be maintained by such shaping and addition of surfacing material as directed by the Government Representative to provide a usable and driveable road under all weather conditions until the new road is completed. No additional payment will be made for this maintenance.

3.3.2 New Road, New Access Ramps and Existing Crown Road

The new road, new access ramps and existing crown road shall be maintained by such shaping and addition of surfacing material as directed by the Government Representative to provide a usable and driveable road under all weather conditions during the construction period. No additional payment will be made for shaping operations. Additional surfacing materials required to repair any damages to the finished surfacing occasioned by the Contractor's construction operations will not be measured for payment. Additional surfacing materials required to repair any damages to the finished surfacing not occasioned by the Contractor's construction operations will be measured for payment.

-- End of Section --
PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT
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PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00 00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4280 (2012) Extended Life Type, Nonplowable, Raised, Retroreflective Pavement Markers

ASTM D4505 (2012) Preformed Retroreflective Pavement Marking Tape for Extended Service Life

ASTM D792 (2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement

ASTM E28 (1999; R 2009) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732 (1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325 (Rev D; Notice 1) Beads (Glass Spheres) Retro-Reflective (Metric)

FS TT-P-1952 (Rev E) Paint, Traffic and Airfield Markings, Waterborne

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

SECTION 32 17 23.00 20 Page 3
Reflective media for roads and streets; G
Paints for roads and streets; G
Thermoplastic compound
Raised Pavement Markers and Adhesive; G

Equipment; G

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Reflective media for roads and streets
Paints for roads and streets
Thermoplastic compound
Raised Pavement Markers and Adhesive

Certified reports from sampling and testing made in accordance with paragraph entitled "Sampling and Testing" prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Reflective media for roads and streets
Paints for roads and streets
Thermoplastic compound

Construction equipment list

SD-08 Manufacturer's Instructions

Paints for roads and streets
Thermoplastic compound

Submit manufacturer's Material Safety Data Sheets.

1.4 DELIVERY AND STORAGE

Deliver paints, paint materials and thermoplastic compound materials in original sealed containers that plainly show the designated name,
specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer. Provide storage facilities at the job site, only in areas approved by the Government Representative or authorized representative, for maintaining materials at temperatures recommended by the manufacturer.

1.5 WEATHER LIMITATIONS

Apply paint to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees above the dew point and the air and pavement temperatures are above 40 degrees F and less than 95 degrees F for oil-based materials; above 50 degrees F and less than 110 degrees F for water-based materials. Maintain paint temperature within these same limits.

1.6 EQUIPMENT

Machines, tools, and equipment used in the performance of the work shall be approved by the Government Representative and maintained in satisfactory operating condition. Submit construction equipment list for approval by the Government Representative.

1.6.1 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

1.6.2 Paint Application Equipment

1.6.2.1 Hand-Operated, Push-Type Machines

Provide hand-operated push-type applicator machine of a type commonly used for application of paint to pavement surfaces. Paint applicator machine shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Applicator for water-based markings shall be equipped with non-stick coated hoses; metal parts in contact with the paint material shall be constructed of grade 302, 304, 316, or equal stainless steel.

1.6.2.2 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

Provide equipment used for marking streets and highways capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines, or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified. Provide paint applicator with paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Equip tanks with suitable air-driven mechanical agitators. Equip spray mechanism with quick-action valves conveniently located, and include necessary pressure regulators and gages in full view and reach of the operator. Install paint strainers in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Provide pneumatic spray guns for hand application of paint in areas where the mobile paint applicator cannot be used. Applicator for water-based
markings shall be equipped with non-stick coated hoses; metal parts in contact with the paint material shall be constructed of grade 302, 304, 316, or equal stainless steel.

1.6.3 Thermoplastic Application Equipment

1.6.3.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.6.3.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.6.3.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

1.6.3.4 Mobile Application Equipment

The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.040 to 0.200 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.
The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame shall not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle.

The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

1.6.3.5 Portable Application Equipment

The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thickness of not less than 0.120 inch nor more than 0.190 inch and of generally uniform cross section.

1.6.4 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph "APPLICATION", at all operating speeds of the applicator to which it is attached.

1.6.5 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.6.6 Surface Preparation Equipment

1.6.6.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles...
of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.6.6.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.6.7 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.6.7.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.6.7.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.6.8 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.7 MAINTENANCE OF TRAFFIC

1.7.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.8 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the
effectiveness of material removal.

1.9 QUALIFICATIONS

The Contractor shall submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials conforming to the requirements specified herein.

2.1.1 Paints for Roads and Streets

FS TT-P-1952, color as indicated.

2.1.2 Reflective Media for Roads and Streets

FS TT-B-1325, Type I, Gradation A.

2.1.3 Thermoplastic Compound

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.1.3.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent by Weight</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Yellow</td>
</tr>
<tr>
<td>Binder</td>
<td>17 min</td>
<td>17 min</td>
</tr>
<tr>
<td>Titanium dioxide</td>
<td>10 min</td>
<td>-</td>
</tr>
<tr>
<td>Glass beads</td>
<td>20 min</td>
<td>20 min</td>
</tr>
<tr>
<td>Calcium carbonate and inert fillers</td>
<td>49 min</td>
<td>*</td>
</tr>
<tr>
<td>Yellow pigments</td>
<td>-</td>
<td>*</td>
</tr>
</tbody>
</table>

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.1.3.2 Physical Properties

a. Drying time: When installed at 70 degrees F and in thicknesses between 0.120 and 0.190 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.

b. Softening point: The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E28.
c. Specific gravity: The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D792.

2.1.3.3 Primer

a. Asphalt concrete primer: The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch, plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

b. Portland cement concrete primer: The primer for portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition.

2.1.4 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D4505 Type I or IV, Class optional.

2.1.5 Raised Pavement Markers

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 4 inches, and shall be spaced not more than 40 feet apart on solid longitudinal lines. Broken centerline marker spacings shall be in segments indicated with gaps indicated between segments. Button markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than 3/4 inch above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D4280

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove rubber deposits, existing paint markings, and other coatings adhering to the pavement by water blasting approved chemical removal method. For Portland Cement Concrete pavement, grinding, light shot blasting, and light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting, to either remove existing coatings or for surface preparation on most pavements: shot blasting shall not be used on airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the
manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

3.2 APPLICATION

3.2.1 Testing for Moisture

Apply pavement markings to dry pavement only. The Contractor shall test the pavement surface for moisture before beginning work after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the CO or authorized representative. Employ the "plastic wrap method" to test the pavement for moisture as follows: Cover the pavement with a 300 mm by 300 mm (12 inch by 12 inch) section of clear plastic wrap and seal the edges with tape. After 15 minutes, examine the plastic wrap for any visible moisture accumulation inside the plastic. Do not begin marking operations until the test can be performed with no visible moisture accumulation inside the plastic wrap.

3.2.2 Rate of Application

3.2.2.1 Reflective Markings

Apply paint evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Collect and record readings for white and yellow retroreflective markings at the rate of one reading per 1000 linear feet. The minimum acceptable average for white markings is 200 millicandelas per square meter per lux (mcd/m²/lx) (measured with Mirolux 12 Retroreflectometer or similar instrument as agreed). The minimum acceptable average for yellow markings is 175 millicandelas per square meter per lux (mcd/m²/lx). Readings shall be computed by averaging a minimum of 10 readings taken within the area at random locations. Areas not meeting the retroreflective requirements stated above shall be re-marked.

3.2.2.2 Nonreflective Markings

Apply paint evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.2.2.3 Thermoplastic Compound

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes. Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch 265 to 400 square feet per gallon. After the primer has "set-up", apply the thermoplastic at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, apply drop-on reflective glass spheres mechanically at the rate of one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If
the plans do not specify a thickness, apply centerline markings at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

3.2.3 Painting

Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

3.2.4 Reflective Media

Application of reflective media shall immediately follow the application of paint. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

3.2.5 Thermoplastic Compound

Place thermoplastic pavement markings upon dry pavement. At the time of installation the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.2.6 Raised Pavement Markers

Prefabricated markers shall be aligned carefully at the required spacing or as directed and permanently fixed in place by means of epoxy adhesives. To ensure good bond, areas where markers will be set shall be thoroughly cleaned by water blasting and use of compressed air prior to applying adhesive.

3.3 FIELD TESTING, INSPECTION, AND DEMONSTRATIONS

3.3.1 Sampling and Testing

As soon as the paint and reflective and thermoplastic materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Government Representative. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved. At the discretion of the Government Representative, samples provided may be tested by the Government for verification.
3.3.2 Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. A certificate of compliance shall be accompanied by test results substantiating conformance to the specified requirements.

3.3.3 Surface Preparations and Application Procedures

Surface preparations and application procedures will be examined by the Government Representative to determine conformance with the requirements specified. Approve each separate operation prior to initiation of subsequent operations.

3.4 TRAFFIC CONTROL AND PROTECTION

Place warning signs near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

3.5 QUALITY ASSURANCE

Demonstrate success of bond of reflective media, new paint marking and the pavement surface, vacuum cured surface of new marking after a seven (7) day dry time. Inspect newly applied markings for signs of bond failure based on visual inspection and comparison to results from Test Stripe Demonstration paragraph.

3.5.1 Reflective Media and Coating Bond Verification

Within seven (7) days after pavement marking application, use industrial vacuum to sweep new markings. Visually inspect the pavement markings and the material captured by the vacuum. Verify that no significant loss of reflective media has occurred to the pavement marking due to the vacuum cleaning.

3.5.2 Reflective Media and Coating Application Verification

Use a wet film thickness gauge to measure the application of wet paint.

Use a microscope or magnifying glass to evaluate the embedment of glass beads in the paint. Verify the glass bead embedment with approximately 50% of the beads embedded and 50% of the beads exposed.

-- End of Section --
PART 1   GENERAL

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2.9 TOP RAIL
2.10 CENTER RAILS BETWEEN LINE POSTS
2.11 POST-BRACE ASSEMBLY
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2.13 STRETCHER BARS
2.14 POST TOPS
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2.16 GATE POSTS
2.17 GATES
2.18 GATE HARDWARE AND ACCESSORIES
2.19 MISCELLANEOUS HARDWARE
2.20 WIRE TIES
2.21 CONCRETE
2.22 GROUT
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3.10 STRETCHER BAR INSTALLATION
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3.12 TIE WIRES
3.13 FASTENERS
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-- End of Section Table of Contents --
PART 1    GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor and materials, and performing all operations in connection with the installation of new chain link fences and gates in accordance with these specifications and applicable drawings.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10, MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Erection/Installation Drawings for the following items in accordance with paragraph entitled, "Assembly and Installations Instructions", of this section.

Fence Assembly;  G
Location of Gate, Corner, End, and Pull Posts;  G
Gate Assembly;  G
Gate Hardware and Accessories;  G

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Fence Assembly;  G
Gate Assembly;  G
Gate Hardware and Accessories;  G
Recycled material content

SD-07 Certificates

Submit Certificates of compliance in accordance with the
applicable reference standards and descriptions of this section for the following items:

Zinc Coating
PVC coating
Aluminum alloy coating
Fabric
Stretcher Bars
Gate Hardware and Accessories
Concrete

SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for the following items:

Fence Assembly
Gate Assembly
Hardware Assembly
Accessories

1.5 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Provide manufacturer's instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit Erection/Installation drawings along with manufacturer's catalog data for Complete fence assembly, gate assembly, hardware assembly and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.7 QUALITY ASSURANCE

1.7.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating, thickness of PVC coating, and chemical composition and thickness of aluminum alloy coating.

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials that conform to the requirements of ASTM A 116, ASTM A 702, ASTM F 626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.
Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A 90/A 90M.

Provide zinc coating that conforms to the requirements of the following:

Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F 1083.

Hardware and accessories: ASTM A 153/A 153M, Table 1

Surface: ASTM F 1043

External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A 780/A 780M.

2.3 FABRIC

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

FS RR-F-191/1; Type I, zinc-coated steel, 9 gage. Mesh size, 2 inches. Provide selvage knuckled at one selvage and twisted and barbed at the other. Height of fabric, as indicated.

Provide fabric consisting of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A 116, ASTM A 702 and ASTM F 626, with 1.29 ounces per square foot zinc galvanizing.

Provide one-piece fabric widths for fence heights up to 12 feet.

2.4 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and up to 60 inches high, and if over 60 inches high, provide twisted and barbed top selvage and knuckled bottom selvage.

2.5 POSTS, TOP RAILS AND BRACES

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A. Braces and rails; Class 1, steel pipe, Grade A, in minimum sizes listed in FS RR-F-191/3 for each class and grade.

2.6 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: DN50 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Grade B: DN60 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.
Over 6-feet high:
   DN50 2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.7 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

   Up to 6 feet high:

   Grade A: DN50 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.
            Grade B: DN60 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

   Over 6 feet high:

   Grade A: DN70 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.
            Grade B: DN70 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

2.8 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.9 TOP RAIL

Provide a minimum of 1.660 inches O.D. pipe rails. Grade A weighing 2.27 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.10 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails, Grade A weighing 2.27 pounds per linear foot.

2.11 POST-BRACE ASSEMBLY

Provide bracing consisting of DN40 1.660 inches O.D. pipe, Grade A weighing 2.27 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.12 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide Zinc Coating that weighs not less than 1.6 ounces per square foot.

2.13 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A 116, ASTM A 702 and ASTM F 626.
2.14 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.15 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.16 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

DN75 2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

Over 6 feet wide and up to 13 feet wide:

DN75 2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

2.17 GATES

FS RR-F-191/2; Type I, single swing. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated. Provide gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade, except that steel pipe frames are a minimum of 1.90 inches o.d., 0.120 inches minimum wall thickness and aluminum pipe frames and intermediate braces are 1.869 inches o.d. minimum, 0.940 lb/ft of length. Gate fabric, is as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Provide plunger bar type gate latches. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

For gate leaves up to 6-feet high or 6-feet wide, provide perimeter gate frames of DN32 1.66 inch O.D. pipe Grade A weighing 2.27 pounds per linear foot.

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of DN40 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.
Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.18 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A 116, ASTM A 702, ASTM F 626, and be as specified:

Provide pressed steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide manufacturer's standard heavy-duty track ball bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required for easy operation of manual sliding gates.

2.19 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.20 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts, spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.21 CONCRETE

Provide concrete conforming to ASTM C 94/C 94M, and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.22 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.23 PADLOCKS

Provide padlocks conforming to ASTM F 883, with chain.

PART 3 EXECUTION

Provide complete installation conforming to ASTM F 567.
3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Uniformly spread soil from excavations adjacent to the fence line or on areas of Government property, as directed.

When solid rock is encountered near the surface, drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated on plans. Compact concrete to eliminate voids, and finish to a dome shape.

3.3.2 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal tension rod.
3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 CENTER RAILS

Provide single piece center rails between posts set flush with posts on the fabric side, using special offset fittings where necessary.

3.7 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.8 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.9 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 2 inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed. Ensure fabric remains under tension after the pulling force is released.

3.10 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.11 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth
operation and lubricated where necessary.

3.12 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.13 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.14 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.15 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.16 SITE PREPARATION

3.16.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.17 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.17.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.17.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.
3.18 ACCESSORIES INSTALLATION

3.18.1 Post Caps

Install post caps as recommended by the manufacturer.

3.18.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.19 GROUNDING

Ground fencing as indicated on drawings and specified.

Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence. Bond each gate panel with a flexible bond strap to its gate post. Provide ground conductor consisting of No. 8 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms.

3.20 SECURITY

Install new security fencing, remove existing security fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with the Government Representative and cognizant Security Officer.

3.21 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --
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DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 34 00.03 00

VEHICULAR PRECAST CONCRETE BRIDGE AND PLATFORM

10/07

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PART 1 GENERAL

1.1 SCOPE

The work shall consist of furnishing, transporting, and erecting vehicular, precast concrete bridge and platforms at the location and to the dimensions shown on the drawings. The vehicular bridge shall be of precast concrete slab sections as shown on the plans and shall be complete with deck sections, precast pile caps, concrete guard rails, dowels and tie rods and cast-in-place concrete abutments, and approach slabs. The platforms shall be of precast concrete slab sections as shown on the plans and shall be complete with deck sections, concrete guard rails, dowels and tie rods. Precast concrete pile caps for the platforms shall be provided where shown in the plans, otherwise the pile caps shall be cast in place. The structures shall be designed for HL93 loading according to the current edition of the American Association of State Highway and Transportation Officials. Additional equipment loads the platforms must support are specified in the plans. This specification does not apply to precast railroad bridges.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A36

ASTM A153

ASTM A307
(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM C1107

ASTM D698
(2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

ASTM D2922
(2005) Density of Soil and Soil-Aggregate
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings;  G

Submit shop drawings showing dimensions and orientation of all precast elements and showing details of all reinforcing, bolts, pins, and other miscellaneous hardware. Include any required embedded items. Submittal shall include the shop drawings in electronic format.

Experience Matrix;  G

Experience matrix to be submitted by Manufacturer shall have been in the precast concrete business for at least five (5) years and shall be approved by the Louisiana Department of Transportation and Development.

PART 2 PRODUCTS

2.1 MATERIALS

The following materials shall conform to the requirements stipulated below.

2.1.1 Concrete

Cast-in-place concrete used for other features of the bridge shall conform to the requirements in Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.1.2 Structural Steel and Miscellaneous Steel

Structural steel for tie-rods shall conform to the requirements of ASTM A36. Tie-rods shall be hot-dip galvanized conforming to the
requirement of ASTM A153.

2.1.3 Hardware

Hardware Drift pins, bolts, steel washers and all other metal items, except C.I.I.G. washers, shall be zinc-coated in accordance with ASTM A307. Bolts and nuts shall meet FS FF-B-575 and FS FF-N-836, respectively.

2.1.4 Joint Material

The 1/2 inch closed-cell polyethylene joint material and poured mineral filler shall be in accordance with LSSRB 1005 and placed where indicated on the drawings.

2.1.5 Neoprene Pads

Elastomeric bridge bearing pads shall conform to LSSRB 1018.13, grade 50.

2.1.6 Crushed Stone

Crushed stone or crushed concrete shall conform to the requirements of Section 32 15 00.00 12 SU. or "Recycled Portland Cement Concrete."

2.1.7 Bolts

ASTM A307, Hot Dipped Galvanized.

2.1.8 Joint Sealer

Polyurethane, such as SL 1 by Sonolastic.

2.1.9 Grout

ASTM C1107 having compressive strength of 3500 psi in 16 hours and 8000 psi in three days, such as Dayton Superior Sure-Grip High Performance Grout.

2.1.10 Piles

Piles supporting the bridge shall be furnished and driven by the Contractor. Pile types and lengths are as described herein and on the drawings.

PART 3 EXECUTION

3.1 CONSTRUCTION SIGNING

Construction signing in accordance with the LSSRB 713 shall be placed as required and shall be kept in place as required throughout the contract period. Any signs, barricades, and delineators that must be replaced for any reason shall be done so at the Contractor's expense. Signs, barricades, and delineators shall conform to the above mentioned publications. Signs, barricades, and delineators shall be removed within 72 hours after the time for which they are no longer needed.

3.2 CRUSHED STONE

Crushed stone shall be placed in loose lifts of six (6) to eight (8) inches and shall be compacted to at least 95 percent of maximum dry density in
accordance with ASTM D698. In place density tests shall be made in accordance with ASTM D2922.

3.3 FABRICATION

Fabricate members to dimensions and details shown on the Contract Drawings. Include reinforcing, curbs, pedestals, openings, embedded items, and other features shown on the Contract Drawings.

Match-cast all adjacent slab sections. Mark each section with an identification mark and number stamped in the concrete to insure correct field assembly.

Apply a light broomed, non-slip finish to slab traffic surfaces.

Apply a steel troweled finish to pile caps. Grind smooth any imperfections to the bearing surfaces.

Cast-in bolts, plates, and other embedded items as required by the Contract Drawings. Include lifting inserts as required to properly handle the members during shipping and erection.

Remove forms only when concrete has attained 2500 psi. Ship units only when concrete has attained 5000 psi.

3.4 INSTALLATION

Utilize proper handling procedures to prevent damage during shipping, storage, and erection. Units which are damaged to the extent that their structural strength is impaired will be rejected.

Install in accordance with manufacturer's recommendations.

Clean all slab joints and remove any loose material and foreign objects before placement of units.

Draw slab units tightly against the preceding slab unit, immediately upon placement. Use mechanical assist tools as necessary to insure a tight fitting joint. Do not use pry bars. Tighten the tie rods only after all slabs have been placed in their final position.

Insure that proper alignment of all units within a span has been achieved before grouting. Mix and apply grout in complete accordance with manufacturer's recommendations. Neatly grout all dowel holes and blend surface to match slab finish. Leave the spans undisturbed after grouting for at least 16 hours or when grout has achieved at least 3500 psi.

Clean the structure thoroughly and inspect all joints for proper size and shape before sealing the joints. Apply sealant in accordance with manufacturer's recommendations.

Repair all damaged galvanized area with approved galvanizing repair compound. Apply in complete accordance with manufacturer's recommendations.

Repair all areas damaged during handling to the satisfaction of the Engineer.
-- End of Section --
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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SCOPE

The work provided herein consists of the Contractor furnishing all plant, labor, equipment, and materials, and performing all operations necessary for turf establishment, maintenance and repairs of previously established areas as specified herein and as indicated on the drawings. Turf establishment of the embankment shall be performed upon completion of embankment work. The Contractor will be required to conduct a post-fertilization of the entire completed levee system, in accordance with recommendations in the soil testing report. The Contractor will be required to repair any damaged or non-growth areas of the entire completed levee system, prior to acceptance.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Seed; G

The Government Representative shall be furnished duplicate signed copies of statements certifying that each container of seed delivered is labeled in accordance with the Federal Seed Act and any Louisiana Department of Agriculture regulations and is at least equal to the requirements specified in paragraph "Soil for Repairs". This certification shall be obtained from the supplier and shall be furnished on or with all copies of seed invoices.

Agronomy Soil Test Recommendations; G

The Contractor shall submit a Agronomy Soil Test Recommendation for approval. The plan shall include recommendations for fertilizer and / or soil amendment application based upon soil testing results by a certified agronomist or soil scientist for each completed section of levee to be turfed. The Contractor shall provide the name of the certified agronomy testing laboratory in addition to copies of the levee/embankment material soil analyses as part of the turf establishment plan. Soil analyses shall include soil pH, phosphorus, potassium, calcium, magnesium, sodium, sulfur, copper, zinc, chloride, total dissolved salts,
conductivity, and sodium absorption ratio. The soil test recommendations shall clearly indicate the required amounts of fertilizer and if necessary, any soil amendments required to adjust the soil pH.

1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control for the work specified in this section to assure compliance with contract requirements and maintain records of this quality control for all construction operations including, but not be limited to, the following:

(1) Soil - Soil analysis reports from a certified agronomic laboratory. Soil samples will be taken in accordance with paragraph "Soil Analysis" and the test results used to determine weights of fertilizer and soil amendments, if required.

(2) Preparation of Ground Surface - Location and quality of finished dressing, including necessary clearing, filling, or dressing out of washes, smoothness and uniformity of surfaces, and time of year.

(3) Herbicides - Not approved for urban areas.

(4) Fertilizing - Quality of initial and post fertilizer materials used. Areas fertilized, quantity applied, and method of application. Certificate of analysis and certificate of delivery shall be furnished to verify quality and quantity as specified in paragraph agronomist soil test recommendations. The rate of application will be checked daily by the Government Representative to insure conformance with post fertilization soil testing recommendations.

(5) Seeding - Seed species and cultivars, seed label, area covered, quantity of seed applied, and method of seed distribution. All bags of seed furnished shall have an analysis tag showing all information required by the Louisiana Seed Law. Seed furnished shall be from the previous season's crop and the date of analysis shown on each tag shall be within 5 months of time of delivery. Rate of application will be checked daily by the Government Representative to insure that the rate conforms to the requirements of paragraph "Seeding".

(6) Mulching - Quality and type of mulch material applied, area covered by the mulch, quantity applied, and method of mulch application. Certificate of delivery showing weight of material delivered for either vegetative or fiber mulch shall be furnished to the Government Representative to verify rate of application according to paragraph "Applying Mulch".

(7) Maintenance and Repair - Location and type of maintenance problems and remedial treatment performed according to paragraph "Soil for Repairs and Damage to Established Seeding Area".

(8) Watering Operation - Water analysis report, source of water obtained, rate of application may vary depending on natural rainfall, quantity per gallons applied to acre, method of application that will not dislodge and wash the seeds to the base of levee (spray nozzle preferred). Water quality shall be checked and tested a minimum of once every 30-days.
1.4.2 Reporting

The Contractor shall furnish the original and two copies of the inspection and test records, as well as "corrective action taken" records, to the Government Representative daily. Format of the report shall be as prescribed in SECTION 01 45 04.00 10, "CONTRACTOR QUALITY CONTROL".

1.5 AREAS TO BE TREATED

All newly constructed embankment slopes and crown, as shown within the construction limits on the contract drawings.

1.6 COMMENCEMENT, PROSECUTION, AND COMPLETION

1.6.1 General

Preparation of the ground surface shall be in accordance with paragraph "Soil Preparation". Seeding application shall be accomplished during applicable growing season indicated in Seeding.

1.6.2 Sequence of Work

The sequence of operations for work prescribed in this section, except mowing, shall be as follows:

(1) Soil Analyses
(2) Preparation of Ground Surface
(3) Fertilization and Soil Amendments, If necessary.
(4) Seeding
(5) Mulching
(6) Water Analyses
(7) Mowing

Fertilizing, seeding and mulching operations shall commence upon completion of embankment construction. The Contractor shall conduct his operations such that fertilizing, seeding and mulching, embankment construction, clearing and grubbing shall be within the length corresponding to the "Embankment Work Advancement" paragraph found in SECTION 31 24 00.00 12. At no time shall establishment of turf operations be more than 14 days behind completed reach of embankment unless approved by the Government Representative.

1.7 SPECIAL EQUIPMENT

1.7.1 Mulch Spreader

The mulch spreader used for applying straw or hay mulch shall be equipped with a blower that is capable of discharging hay or straw mulch material through a discharge spout at speeds up to 220-feet per second. The discharge spout shall be capable of 360-degree horizontal rotation and have a minimum of 60-degree range of elevation and depression. The mulch spreader shall be equipped with a tackifier supply and application
system, near the discharge end of the boom spout that is capable of applying adhesive in atomized form to the mulch material at a predetermined rate. The spreader shall be capable of blowing the adhesive coated mulch over the surface of a graded or otherwise prepared slope at a uniform rate, forming a porous, stable, erosion-resisting cover at a distance of not less than 100-feet.

1.7.2 Wood Cellulose Fiber Mulch Spreader

Hydraulic equipment used for the application of slurry of prepared wood pulp shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix slurry containing up to 300 pounds of fiber for each 1000 gallons of water. The slurry distribution lines shall be large enough to prevent clogging or stoppage. The discharge line shall be equipped with hydraulic spray nozzles that will provide even distribution of the slurry on the various slopes to be mulched. The discharge spout shall be capable of 360-degree horizontal rotation and have a minimum of 60-degree range of elevation and depression. The slurry tank shall have a minimum capacity of 1,000 gallons and shall be mounted on a traveling unit, which may be either self-propelled or drawn by a separate unit that will place the slurry tank and spray nozzles near the areas to be mulched so as to provide uniform distribution without waste. The Contacting Officer may authorize equipment with a smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform seat over the surface of the area to be mulched.

1.8 AGRONOMY SOIL TEST RECOMMENDATIONS

Soil samples for testing shall be submitted to laboratory/agronomist 15 working days period to completing an embankment for each reach in order to expedite turfing operation. One soil testing result will not be accepted as representation of the entire levee alignment. Each completed levee reach to be turfed shall require soil samples. Results shall be recommended application rates, the percentages for nitrogen, phosphorus, potash and gallons of water per acre. The results shall also indicate if soil amendments, such as lime, sulfur are required for treatment of embankment. Recommendations based on soil testing results can be from a testing laboratory, state agricultural extension services, or private consultant and signed by a certified agronomist or soil scientist.

1.8.1 Certified Water Analysis

The Contractor shall also provide the name of the certified water analysis laboratory as well as copies of the findings for all proposed water sources, other than municipal water sources, earmarked for grass establishment and irrigation. Water analyses shall include pH, alkalinity, calcium, chloride, iron, magnesium, manganese, potassium, sodium, sulfur, total dissolved salts, conductivity, and sodium absorption ratio.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Fertilizer and Soil Amendments

Fertilizer and soil amendments shall be of commercial grade, uniform in composition, free flowing and suitable for the Contractor's application
method. Materials shall be delivered in bulk or labeled containers and shall conform to current Louisiana Department of Agriculture requirements for commercial fertilizers and soil amendments. Federal and state Government conforming labels that indicate producer's name, type, analysis, weight, and warranty of producer shall accompany each delivery of fertilizer. The Contractor shall provide duplicate signed copies of invoices from suppliers of fertilizer and/or soil amendments showing quantity, grade, and fertilizer analysis indicating percentages of nitrogen (soluble and insoluble), phosphorus, and potassium.

2.1.2 Soil for Repairs

In areas not suitable for turf establishment due to undulations, poor soil quality or rills, equipment tracking on the soil surface, these areas shall be repaired using compacted fill in accordance with Section 31 23 00.00 12 "Excavation" and Section 31 24 00.00 12 "Embankment".

2.1.3 Seed

For turf establishment, the Contractor shall furnish and apply certified (blue-tag) seed in accordance with regulations from the U.S. Department of Agriculture (under the Federal Seed Act) and the Louisiana Department of Agriculture. Seed must be in sealed or unopened containers prior to initiation of application. Seed that is wet, moldy or otherwise non-viable due to damage in transit or storage will not be accepted. Seed that is older than one year past label germination tests will not be accepted.

2.1.4 Mulch

Mulch options include threshed straw from a cereal grain such as oats, wheat, barley, rye, or rice; bagasse; grass hay; or wood fiber that shall be furnished and applied by the Contractor. All mulch products shall include an approved tackifier or be anchored by a method approved by the Government Representative. Materials that contain noxious grass or weed seeds that might be detrimental to the seed establishment or turf growth or to adjacent areas will not be acceptable. Mulch shall contain not more than 30 percent paper fiber product.

2.1.4.1 Wood Cellulose Fiber or Recycled Wood Pulp Mulch

The wood cellulose fiber mulch with tackifier for use with hydraulic application equipment shall consist of wood cellulose fiber. If the recycled wood pulp mulch option is used, the recycled wood pulp mulch for use with hydraulic application equipment shall consist of pulped ecology by-product made from printer's scrap paper, which contains wood cellulose and kaolin clay to provide non-toxic organic tackifier. The mulch shall be processed to contain no growth or germination inhibiting factors, and dyed an appropriate color to facilitate visual metering of application of the materials. The mulch material shall be supplied in packages having a net weight not in excess of 100 pounds. The wood cellulose mulch fiber shall contain not in excess of 10 percent moisture, by air-dry weight basis. The wood cellulose mulch fiber shall be manufactured so that after addition and agitation in slurry tanks, with water, and any other additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry, and that when hydraulically sprayed on the ground, the material will form a blotter like ground cover which, after application, will allow the absorption of moisture and allow rainfall or mechanical watering to percolate to the underlying soil. The Contractor
shall be prepared to submit, on request, certification from the supplier that laboratory and field testing of the product has been accomplished, and that the product meets the foregoing requirements.

2.1.5 Water Source

Water, applied during establishment and irrigation of grass on the embankment from a water source other than municipal water supply shall be analyzed by a certified water analysis laboratory. The water source shall be tested every 30 days or until operations cease use of the water source for irrigation purposes. In addition to the agronomic tests to determine irrigation water suitability, the contractor should not apply water as irrigation that may contain any substance toxic to plants or that limits plant growth (e.g. oil, acid, alkali, salt, etc.).

PART 3 EXECUTION

3.1 SOIL AND WATER ANALYSIS

3.1.1 Soil Analysis

Soil samples shall be collected for each completed reach of embankment. Soil shall be a composite sample from no less than six random areas (3 each side of levee crown) to a depth of four inches on the levee/embankment surface. Collected soil shall be mixed within a clean, non-metallic container. All organic matter from existing vegetation shall be removed from the soil sample prior to submission to the testing laboratory, unless vegetative material is required to be placed back onto the embankment.

3.1.2 Water Source Analysis *(Not Municipal Water Source)

Water samples from borrow canals or similar sites should be collected in duplicate in the volume of one liter (per sample) in a clean plastic container for analysis by a certified agronomic water analysis laboratory. Debris such as sediment and algae shall be limited from within the sample.

3.2 PREPARATION OF GROUND SURFACE

3.2.1 General

Equipment, in good condition, shall be provided for ground preparation and for handling and placing all materials. The Government Representative shall approve equipment before work is initiated as part of the Turf Establishment Plan.

3.2.2 Vegetative and Debris Removal

Vegetation removal may be accomplished through mowing (scalping). Any debris (rocks/stones) or material (e.g. clippings) that may hinder seed germination or limit plant growth or interfere with mowing operations shall be removed as specified in Section 31 11 00.00 12, paragraph "Disposal of Debris". The Contractor shall utilize a landscape rock rake or similar equipment supplement with hand labor to remove this debris prior to fertilizing, seeding and mulching.
3.2.3 Grading

Previously established levee/embankment grades and slopes shall be maintained in a true and even condition on the areas to be established with turf. Repairs to previously graded areas with undulations or irregularities in the surface shall be accomplished with material as described in paragraph "Soil for Repairs". The material shall be placed and compacted in accordance with Section 31 24 00.00 12, paragraph "Embankment Construction". Where grades have not been established, the areas shall be graded as shown, or as directed by the Government Representative and all surfaces shall be left in a true and even condition. The Government Representative will conduct a pre-turfing inspection prior to commencement of turfing operations.

3.2.4 Soil Preparation

Soil shall be tilled to a depth of 2 inches by plowing, disk ing, harrowing, or other approved methods in order to provide an acceptable seed bed. The soil preparation shall be performed only during periods acceptable for turf establishment, in the opinion of the Government Representative. Environmental conditions that may constitute unacceptable periods for soil preparation include, but are not limited to, drought, high winds, excessive moisture, etc. The work shall cease until conditions are more favorable for turf establishment. Any additional soil repair shall be completed prior to turf establishment.

3.3 APPLICATION OF FERTILIZER AND SOIL AMENDMENTS

Unless otherwise specified in the approved plan, initial fertilizers and soil amendments, if required, shall be incorporated into the top two inches of soil prior to seeding. The Contractor shall layout the embankment sections in one acre plots, which are clearly marked with stakes and flagging, to assure the correct amount of soil amendments, seed and mulch applied per acres.

3.3.1 Soil pH

Soil pH shall be between 5.4 and 8.2. If the soil pH is outside of this range, one of the following amendments shall be added to adjust the soil pH.

3.3.1.1 Increasing Soil pH

A pulverized or palletized agricultural lime source shall be applied prior to planting and incorporated into the top 2 inches of soil. The rate of lime application shall be as specified in the approved agronomist soil test recommendations. Dolomitic lime may be substituted for lime if magnesium levels are insufficient in accordance with the soil test results.


2. The quantity of lime to be mixed with the embankment shall be determined by the testing results, and shall be sufficient in quantity to permit compaction to the specified density.

3. The lime shall be uniformly spread and uniformly mixed with the soil.

4. One ton of lime per acre to raise pH one unit.
3.3.1.2 Reduce Soil pH

Agricultural grade elemental sulfur shall be applied, as specified in the approved agronomist soil test recommendation, prior to planting. Elemental sulfur shall be incorporated into the top two inches of soil.

1. 1/2 ton of sulfur per acre to lower pH one unit.

3.4 FERTILIZER

In accordance with the approved soil test recommendation, fertilizer shall be incorporated to a depth of 2-inches prior to seeding. The fertilizer shall be uniform in composition and free flowing. The fertilizer shall meet the requirements for commercial fertilizer and shall contain, a minimum of 60 pounds of available nitrogen, 60 pounds of available phosphorous, and 60 pounds of available potash. The fertilizer shall be delivered to the site in bags or other convenient containers or delivered in bulk. If delivered in bags or containers, the fertilizer shall be fully labeled in accordance with the applicable state fertilizer laws and shall bear the name, tradename or trademark, and warranty of the producer. Should the commercial fertilizer be furnished in bulk, the Contractor shall furnish certified weight tickets and a certified quantitative analysis report, in triplicate, from a recognized testing laboratory certifying the nutrient ration of the materials.

3.4.1 Post-Fertilizer

The Contractor may be required to post fertilize and watering in accordance with the approved agronomist lbs per acre soil test recommendation.

3.5 SEEDING

3.5.1 General

The applicable seed shall be sown at the rate and time as indicated in the table below, unless otherwise specified in the approved agronomist soil test recommendations. A method of sowing shall be employed; using approved mechanical power-drawn seeders, mechanical hand-seeders, broadcast-seeders, or other approved methods. When delays in operations extend the work beyond the most favorable planting season for the species designated, or when conditions are such by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, work shall be stopped as directed by the Government Representative and resumed only when conditions are favorable for turf establishment or when approved alternative or corrective measures and procedures have been completed. If inspection during or after seeding operations indicates that areas have been left unplanted or other areas have not been adequately addressed, additional seed shall be applied.

<table>
<thead>
<tr>
<th>Season</th>
<th>Seed Type</th>
<th>Rate (lbs per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1 to September 1</td>
<td>hulled common Bermuda grass</td>
<td>75 lbs (min) of PLS/acre</td>
</tr>
<tr>
<td></td>
<td>seashore paspalum</td>
<td>75 lbs (min) of PLS/acre</td>
</tr>
<tr>
<td>September 1 to March 1</td>
<td>unhulled common Bermuda grass</td>
<td>65 lbs (min) of PLS/acre and</td>
</tr>
<tr>
<td></td>
<td>annual, intermediate or perennial ryegrass</td>
<td>50 lbs (min) of PLS/acre</td>
</tr>
</tbody>
</table>
Hulled Bermuda grass may be planted in the month of February if soil temperatures are in excess of 65°F for a minimum of 7 consecutive days.

\[
\text{PLS (Pure Live Seed)} = (\text{label germination rate} \times \text{label purity}) \times 100
\]

Example of how to calculate PLS

\[
\text{PLS} = (0.95 \text{ germination rate} \times 0.85 \text{ purity}) \times 100
\]

\[
\text{PLS} = 81\%
\]

Therefore 1 lb PLS requires \(1/0.81 = 1.23\) lbs of seed

3.5.2 Broadcast Seeding

Seed shall be broadcast with approved sowing equipment and distributed uniformly over designated areas at the appropriate seeding rates. After broadcast seeding, seed shall be covered to an average depth of 1/4-inch using a brush, harrow, spike-tooth harrow, chain harrow, cultripacker, or other approved device. In addition, after soil amending and seeding, the soil shall be compacted using a tractor drawn pull behind smooth drum roller or other approved equipment necessary to compact the soil to prevent erosion prior to mulching. Seed shall not be broadcast during windy or inclement weather.

3.5.3 Damage to Established Seeding Area

The Contractor shall be fully responsible for repairing any damage to the establishment areas caused by turfing operations, during the duration of the contract period. Areas that become damaged as a result of poor workmanship as determined by the Contraction Officer's representative and fail to meet the requirements of the specifications will be ordered repaired and reseeded to specification requirements, without any additional cost to the Government.

3.5.4 Hydraulic Seeding

If the hydraulic method of seeding is used, no more than 50% of the required amount of seeds shall be mixed with the slurry. The remaining 50% of the seeds shall be broadcast into the soil in accordance with paragraph "Broadcast Seeding". Seeds shall be combined with fertilizer and mulch and applied uniformly with equipment meeting the requirements of paragraph 1.9.

3.6 APPLYING AND ANCHORING MULCH

Application of mulch shall follow these guidelines unless otherwise specified in the approved agronomist soil test recommendation.

3.6.1 Mulch

The mulch shall be applied by means of approved equipment suitable for such work. Mulch as specified in paragraph 2.1.4, shall be applied uniformly on the soil surface at the rate of 3,500 pounds per acre. Dry broadcast mulch and/or Hydrological-placed mulch shall be done immediately after seeding. Dry broadcast type mulch shall be tacked by spraying with an approved tackifier at the rate recommended by manufacturer.

3.6.2 Wood Fiber Mulch

Wood fiber, as specified in 2.1.4 shall be applied uniformly on the soil
at the rate of 3,500 pounds per acre during the seeding operation with equipment as specified in paragraph "AGRONOMY SOIL TEST RECOMMENDATIONS".

3.7 WATER APPLICATION

Unless the Government Representative concurs that acceptable levels from natural rainfall have occurred to support grass establishment, watering operations will be conducted one to two days after seeding. Routine watering shall be applied at least 2 times per week after initial watering for a period of 28 days unless otherwise directed by the Government Representative. The water application shall sufficiently moisten at least the top 2 inches of soil with each watering application. The Contractor shall prevent excessive water application, so that surface runoff of seeds does not occur. Damage areas caused by the Contractor's watering operation shall be repaired. All work effort associated with repairs will be at no additional cost to the Government.

3.8 MOWING

3.8.1 New Turf Maintenance

Turf areas established under this contract shall be mowed to a height of 3 to 4-inches whenever the height of the vegetation is in excess of 8 inches. Grass chippings created from mowing that will inhibit turf establishment shall be removed from the site. The Contractor shall perform periodic and final grass mowing within the limits of work until final inspection and acceptance of levee work.

3.8.2 Maintenance Time Period

For the duration of the contract, the Contractor shall maintain established turf within the limits of the levee work as shown on the drawings.

3.9 INSPECTIONS AND REPORTS

After initial turfing operations, the Contractor shall inspect new turfed areas at least once every two weeks. For each inspection conducted, the Contractor shall prepare a written report summarizing the scope of the inspection, names of personnel making the inspection, inspection date, height of vegetation, observations and conclusions, maintenance performed, and corrective actions, if required. The report shall be furnished to the Government Representative within 24 hours of the inspection as a part of the Contractor's daily QC Report.

3.10 AREAS OF NON-GROWTH

The Contractor shall restore/repair any eroded areas or bare spots along the alignment in accordance with the requirements of this specification, all at no additional cost to the Government.

3.11 ACCEPTANCE BY GOVERNMENT

Turf will be considered completed when the areas to be treated have produced the required grass species, either Bermuda or Seashore Paspalum, over a minimum of eighty-five percent of the entire area as determined by the Government Representative by random observation. If the Government Representative determines the areas of non-grass growth unacceptable, the Contractor will required to repair and re-seed the area.
The repair area work effort and materials will be performed at no additional cost to the Government. Final acceptance will only be considered after the entire levee alignment has been turfed. There will be no partial segment/reach fully accepted.

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DIVISION 33 - UTILITIES

SECTION 33 05 00.00 12

MODIFICATIONS TO EXISTING UTILITIES

11/01

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1.3 SUBMITTALS
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   1.4.2 Reporting
1.5 QUALITY OF WORK
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-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment and materials required to perform the operations in connection with the modification of existing utilities. The work specified herein includes providing:

1. Contractor shall review the proposed utility relocations shown on plans. Contractor shall contact Louisiana One call (1-800-272-3020), 48 hours prior to beginning any work in project area to locate all utilities in the work zone.

2. Contractor shall give notice to the owner(s) in charge of streets, gas, water, sewer, electric, telephone, and cable services as well as to the operators of pipelines and other industrial facilities that may be affected by the Contractor's operations. Such notice shall be given at least 48 hours before his operations will affect such components. Contractor shall coordinate the relocation and or alteration of all utilities and industrial facilities with the responsible utility or industrial company.

3. Coordination with the Louisiana Department of Transportation and Development (LADOTD). The contractor shall be responsible to protect LADOTD's facilities during construction.

4. Coordination with Atmos Energy to identify and verify existing gasline location and requirements for installation of new gas line to pump station, and requirements for protecting and supporting the existing gaslines during construction.

5. Coordination with St. John The Baptist Parish - Contractor shall coordinate with the Parish to install new water pipe and to tie-in to existing water main.

6. Coordination with Entergy to identify and verify existing power lines and structures and requirements for de-energization and re-energization of lines during construction.

7. The Contractor shall coordinate with the following utility companies at least __________ weeks in advance of any construction in the vicinity of their utilities.

<table>
<thead>
<tr>
<th>Utility Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Comcast (Time Warner)</td>
</tr>
</tbody>
</table>

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All work shall be inspected and approved by the Government Representative before covering with backfill. No elevations, slopes, or dimensions of existing utilities shall be changed unless specified on the drawings or otherwise directed by the associated utility owner and Government Representative.
1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule; G

Thirty (30) days before work is performed on any utility, the Contractor shall prepare and submit for approval of the Government Representative a schedule indicating the proposed date and time each utility service will be interrupted and the date and time of permanent replacement.

SD-02 Shop Drawings

Shop Drawings; G

The Contractor shall prepare and submit for the approval of the Government Representative complete shop drawings showing details of the modifications and all work associated with affected utilities.

SD-03 Product Data

Manufacturer's Certifications

The Contractor shall submit manufacturer's detailed product data for materials, fabrication and installation certifying that all products meet or exceed specified requirements.

SD-11 Closeout Submittals

Record of Existing Conditions

The Contractor shall prepare and submit a record of the actual locations of utility lines, elevations and discovery of uncharted utilities.

As-built Drawings; G

Prior to final inspection and testing of the utility system, the Contractor shall submit to the Government Representative and the Owner of applicable utilities, "as-built" drawings, showing all changes in alignment or elevation from the existing location of piping and connections.
1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control for utility modification operations to assure compliance with the contract specifications, schedule and maintain records of his quality control for all construction operations including but not limited to the following:

(1) Checking construction operations and certifying compliance with applicable sections of the specifications,

(2) Checking materials to be used in utility modification. The Contractor shall certify that all materials are in compliance with applicable regulations.

1.4.2 Reporting

The original and two (2) copies of these records of tests, as well as the records of corrective action taken shall be furnished to the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.5 QUALITY OF WORK

1.5.1 Manufacturer's Certifications

The Contractor shall submit manufacturer’s certificates for detailed product data for materials, fabrication and installation certifying that all products meet or exceed specified requirements.

1.5.2 Excavation and Backfill

Prior to commencing work, the Contractor shall prepare and submit a schedule indicating the dates of utility interruption and time for completion of the work. All excavation and backfill adjacent to the culvert required for modifications to existing utilities shall conform to the applicable provisions of specifications.

1.5.3 Record of Existing Conditions

The Contractor shall provide a record of existing locations showing the actual locations of utility lines, valves, structures and elevations and discovery of uncharted utilities.

1.5.4 Shop Drawings

The Contractor shall prepare and furnish shop drawings detailing the modification work to be performed to the Government Representative for approval prior to commencing work.

1.5.5 As-built Drawings

Prior to final inspection and testing, the Contractor shall submit to the Government Representative and the Utility Owners "as-built" drawings, showing all changes in alignment or elevation from the existing location of utility conduits, piping and connections.
1.5.6 Existing Utilities

The elevations, slopes, and dimensions of the existing utilities shall not be changed unless shown on the shop drawings or directed by the Government Representative.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 MODIFICATIONS TO EXISTING UTILITIES

3.1.1 Schedule

Thirty (30) days prior to commencing work on any utility, the Contractor shall submit a Work Plan and schedule indicating the dates of utility interruption and date for completion of the work.

3.1.2 Cooperation With Owners

The Contractor shall carefully plan and expeditiously prosecute the work in such manner as to cause the least interruption to services of the utility lines. The Contractor shall coordinate the utility modifications with the utility owners so that no delay, interference or access problems occur.

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LARGE DIAMETER STEEL PIPE

10/06

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)


AWWA C200  (2012) Steel Water Pipe – 6 In. (150 mm) and Larger


AWWA C206  (2011) Field Welding of Steel Water Pipe

AWWA C207  (2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.


AWWA C600  (2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C606  (2011) Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B18.2.2  (2010) Standard for Square and Hex Nuts

ASME B18.5.2.1M  (2006; R 2011) Metric Round Head Short Square Neck Bolts

ASME B18.5.2.2M  (1982; R 2010) Metric Round Head Square
1.3 DESIGN REQUIREMENTS

1.3.1 Steel Discharge Pipe

Provide 24-inch by 3/8-inch, 36-inch by 3/8-inch and 72-inch by 1/2-inch steel pipes as indicated on the drawings. Provide accessories where indicated.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials; G

Steel discharge pipe, fittings, joints, valves, and couplings.

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for dresser style joints. Include information concerning gaskets with submittal for joints and couplings.

SD-07 Certificates
Piping, fittings, joints, valves, and coupling
Shop-applied lining and coating; G
SD-08 Manufacturer's Instructions

Delivery, storage, and handling
Installation procedures for steel discharge piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site under protective covering. Store jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, and valves free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, and other accessories in a manner to ensure delivery to the site in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the site. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter during installation operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective shall be replaced with sound material without additional expense to the Government.

1.5.2.1 Coated and Wrapped Steel Pipe

Handle steel pipe with coal-tar epoxy coating in accordance with the provisions of AWWA C203 and Section 09 97 02.01 12 PAINTING: COAL TAR EPOXY SYSTEM.

PART 2 PRODUCTS

2.1 STEEL DISCHARGE PIPE MATERIALS

2.1.1 Piping Materials

2.1.1.1 Steel Discharge Piping

a. Pipe and Fittings: Pipe, AWWA C200. Fittings, AWWA C208 and to AWWA C200, with reference to the requirements specified therein for "Special Sections". Pipe and fittings shall have coal-tar epoxy coating in accordance with Section 09 97 02.01 12 PAINTING: COAL TAR EPOXY SYSTEM. Ends of pipe and fittings shall be suitable for the joints and jointing materials used.

1. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 for use with mechanical
couplings. Spiral welded pipe will not be permitted for discharge pipe.

2. Fittings and specials shall be made of the same material as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. The thickness rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same material used for the pipe with the same number of applications of each material, smoothly applied.

b. Wall Thickness for Pipe and Fittings: The minimum metal thickness for steel pipe wall shall be as shown on plans and based on steel having a tensile strength of 60,000 psi.

c. Joints and Jointing Materials

   (1) Joints: Joints for pipe and fittings shall be welded joints, the mechanically coupled type using a sleeve-type mechanical coupling.

   (2) Welded Joints: Electrodes shall be of the quality specified in AWWA C206.

   (3) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings".

   (4) Flanged Joints: Provide pipe ends with steel flanges, AWWA C207; Class D. Bolts and nuts for flanged connections, AWWA C207. Rubber gaskets, AWWA C207; asbestos gaskets will not be allowed.

d. Lining and Coating:

   Steel discharge pipe shall be painted on both inside and outside with coal tar epoxy coating system.

   (1) Coal-Tar Epoxy Coating: Clean, prime, and topcoat piping with coal-tar epoxy coating system in accordance with AWWA C210. Shop-apply coating, and Section 09 97 02.01 12 PAINTING: COAL TAR EPOXY SYSTEM.

2.1.2 Valves and Other Accessories

2.1.2.1 Air Release Valve

The double door check valve shall be compact water/air design to fit between ANSI flanges rated at 125 psi.

The check valve doors shall be spring loaded, normally closed, by means of one or more heavy duty stainless steel torsion springs. Air flow from the
A discharge tube shall cause the doors to open and the torsion spring shall shut doors upon pressure equalization.

Seating shall be resilient and water tight. The sealing element shall be buna-n molded to the body. Valves 5 inches and larger shall be fitted with a lifting hook for installation purposes. All materials of construction must be certified in writing to ASTM specifications as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Ductile Iron (ASTM A536)</td>
</tr>
<tr>
<td></td>
<td>Cast Steel (ASTM A216) WCB</td>
</tr>
<tr>
<td></td>
<td>Cast Iron (ASTM A126) GR.B</td>
</tr>
<tr>
<td>Doors</td>
<td>Cast Steel (ASTM A216) WCB</td>
</tr>
<tr>
<td></td>
<td>Aluminum Bronze (ASTM A148) C95200</td>
</tr>
<tr>
<td>Sealing Element</td>
<td>BUNA-N</td>
</tr>
<tr>
<td>Torsion Spring</td>
<td>T 316 Stainless Steel</td>
</tr>
<tr>
<td>Hinge Shaft</td>
<td>T 316 Stainless Steel</td>
</tr>
<tr>
<td>Stop Shaft</td>
<td>T 316 Stainless Steel</td>
</tr>
<tr>
<td>Exterior Paint</td>
<td>Phenolic Primer Red Oxide</td>
</tr>
</tbody>
</table>

Double door check valves shall be APCO Series 9000-9000E-9000L-9400, as manufactured by Valve and Primer Corp., or approved equal.

2.1.2.2 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For steel piping, the middle ring shall be of steel and the follower rings shall be of steel. Steel shall have a strength not less than that of the pipe. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be 5/8-inch in diameter; minimum number of bolts for each coupling shall be for 36-inch pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline. Couplings shall conform to ASTM F1476, Type II, Class 3. Gasketed mechanical coupling shall be Dresser Style 38 restrained or an approved equal.
2.1.2.3 Bonded Joints

Joint restraints across mechanical couplings shall be as shown in the drawings.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES (LAYOUT)

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made.

3.1.1.1 Layout

Accurate and precise layout of the fabricated pipe systems is essential to insure the proper fit-up in the field. Of particular importance are the miter cuts used to make elbow sections and offsets. Precise wrap-around templates shall be used. In addition the layout of the longitudinal scribed lines used to position the templates shall receive great care.

3.1.1.2 Welds

A. Welds (shop and field) shall be Double Bevel Groove complete penetration welds.

B. All welds for use on this portion of the contract shall be composed of multiple passes of "stringer" beads. Stringer beads are herewith defined as a weld bead quickly deposited in a straight line, without a "weave" or rod tip pattern, and without any large puddle. It shall be the equivalent of a 1/4" fillet weld deposited in one pass.

C. Welding rods used shall be 1/8" and 5/32" diameter, "Fleetweld #5" conforming to the A.W.S. Class E-6010, or as approved equal.

D. Before a new pass of weld is laid upon previously deposited weld, the older weld shall be thoroughly cleaned of slag.

E. Particular attention shall be given to the edges of the older weld. After the deposition of each rod, the weld shall be peened using an air powered chipping gun with appropriate tool bit. This weld is progressively stress relieved.

F. All welds will be of size, length, and type as shown on the drawing. Where no weld designation is given, all structural welds will be continuous and will be properly sized to develop the full strength of the smaller of the two members being joined.

G. All welds shall be ground flush on inside of pipe.

H. All Double Bevel Groove welds shall be in accordance with the current A.S.M.E. code for Unfired Pressure Vessels.

3.1.1.3 Control of Weld Distortion, Stress Relief

A. The sequence of welding operations, particularly at flanges, shall be such as to minimize and control shrinkage distortion. In
addition to post-weld peening, certain welded pieces shall be heated by appropriate means to the proper annealing temperatures, and then cooled slowly so as to effect stress relief. It is to be noted that stress relief is essential. The Contractor shall submit a written procedure for the stress relief of those pieces requiring same, for approval giving specific details on method, temperature ranges, cooling, as well as, details on the quality assurance organization as will assure the attainment of the customers intent. The Owner will require certification of the stress relief procedures, and reserves the right to employ an independent testing lab to review the actual stress relief work.

B. Pieces requiring stress relief in accordance with this paragraph shall be all machine flanged end pieces.

3.1.1.4 Appearance Grinding

A. All edges of ribs shall receive appearance grinding so as to chamfer the corners and remove gas cut ripples. The inner and outer surfaces of shell butt welds shall be ground so as to remove weld ripple, but not necessarily ground flush (except at flange and rib locations).

B. All surface defects resulting from the welding and subsequent removal of fit up clamps, clips, dogs, etc. shall be ground smooth.

3.1.1.5 Plate Edges

A. Pipe shell plate edges for welds, either shop or field, shall be carefully prepared so that the gap does not vary more than 0.060 plus or minus from nominal. Gas cut edges shall be smooth and free from gas cut ripples, and/or "melt" beads on the underside. Specifically, disc grinding of the gas cut edges is required.

B. The inside and outside edges of plate ribs shall be similarly prepared.

3.1.1.6 Plate Rolling

A. The minimum spacing of circumferential joints shall be twenty feet.

B. The number and location of longitudinal seams is at the Contractor's option. However the leading and trailing edges of each plate segment shall be so fabricated, with additional forming as may be required, as to specifically avoid any "flat" in the vicinity of the longitudinal seams. In other words the transverse curvature of the cylindrical segments shall be uniform within the limits herein specified.

3.1.1.7 End Bracing

The purpose of temporary end bracing is threefold; to hold the ends securely round, to prevent shipping and handling distortion, and to assist in field fit-up. End bracing shall be structural angles on the 1/8 points of the end cross-section and shall incorporate a central plate, and pads at each peripheral point of contact to distribute load.
3.1.1.8 Handling

A. All steel pipe shall be handled and transported with equipment provided with stout wide canvas or rubber-nylon fiber slings and wide padded skids or cradles, designed, constructed and arranged to prevent damage to the pipe coating. Bare cables, chains, hooks, metal bars or narrow skids or cradles will not be permitted to come in contact with the coating and lining. All pipe handling or transportation equipment shall be approved by the Engineer prior to their use and the Engineer reserves the right to discontinue any handling equipment that he considers damaging to the coating or lining.

B. During hauling, all pipe shall be supported in wide cradles or suitably padded timbers that are formed to fit the curvature of the pipe, all chains, cables or other equipment used to fasten down the pipe shall be carefully tightened and well padded.

C. Pipe stored at a storage or job site shall be supported on padded wooden skids, not smaller than 4 inches x 4 inches in size with intermediate padded supports as required. Pipe shall not be permitted to be rolled, skidded or otherwise moved when in contact with the ground.

D. Pipe shall be hoisted into place by means of wide slings of canvas, leather, or other similar material approved by the Engineer. The use of cables, chains, hooks, covered or uncovered or other devices which may cause damage to the coating or lining will not be permitted. The Contractor shall allow for inspection of the bottom side of the pipe for damage to the coating prior to final inspection. If the coating is damaged, the coating shall be repaired before final installation.

E. At all times during pipe installation, the Contractor shall use every precaution against damage to the coating. Workmen shall not be permitted to walk on the coating or lining except when necessary and then only if such workmen are wearing shoes of rubber or composition soles and heels.

F. Any pipe section or special section that shows dents, kinks, abrupt changes or curvature other than specified, or any other defects at the installation site will be rejected. The Contractor shall replace, at his own expense, such rejected sections.

G. All field joints, welds and adjacent damaged coatings shall be cleaned and blasted in accordance with SSPC-SP10 Near-White Metal Blast Cleaning. Recoat all field joints, welds, and damaged coatings in accordance with Section 09 97 02.01 12, PAINTING: COAL TAR EPOXY SYSTEM.

3.1.1.9 Handling Eyes

A. Handling eyes and other lifting appurtenances are not shown on the drawings, particularly because the location of field welds is not known. In general, handling eyes shall consist of drilled (not burned) holes in transverse stiffener ribs, and the rib is to be appropriately reinforced with perpendicular gussets.

B. The location of handling appurtenances shall be determined by the Contractor, and details thereof submitted for review, including
details upon the weights to be lifted, centroid of weight, etc.

C. Handling appurtenances shall comply with applicable O.S.H.A. standards.

3.1.1.10 Installation

A. The installation will require temporary support systems to temporarily support the dead loads, as well as resist any lateral and upward forces during installation.

B. The Contractor shall submit a support plan for prior review that will completely define the temporary support system.

3.1.1.11 Joint Installation

A. The discharge pipes are each provided with a mechanical joint assembly. The assembly must be aligned with considerable care so as to prevent any initial offset as would impair the function of the joints to absorb future movements.

B. The faces of the flanges of the joints shall be held parallel within 0.060", and the centerlines at the flanges shall be coincident within 0.030 inch vertically and 0.040 inch horizontally.

C. The Contractor shall have available, throughout the assembly period, the necessary measurement appurtenances such as inside micrometers, precision straight edges, precision optical level, and so forth, as will allow the checking of the alignments. The Contractor is advised that the proper alignment of the joints is a work effort requiring craft skill associative with machinery setting in order to attain the degree of precision required.

3.1.1.12 Machinery Representative

A. The Contractor will be represented by his Machinery Representative, who will be observing the erection of all piping, associated joints, and the connection of same to the required pumps.

B. The Machinery Representative will check all alignments, the torque requirements on fasteners, the erection of connecting piping, and in general, observe compliance with these specifications.

3.1.1.13 Torque Requirements, Fasteners

All nuts and bolts, cap screws, anchor bolts, and other threaded fasteners shall be tightened by using torque wrenches. The torque requirements of each size fastener shall be as follows:

<table>
<thead>
<tr>
<th>Size Bolt</th>
<th>Torque, Grade 2 Bolts (Foot-lbs.)</th>
<th>Torque, Grade 5 Bolts (Foot-lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>155</td>
<td>260</td>
</tr>
<tr>
<td>7/8&quot;</td>
<td>160</td>
<td>415</td>
</tr>
<tr>
<td>1&quot;</td>
<td>233</td>
<td>640</td>
</tr>
<tr>
<td>1-1/8&quot;</td>
<td>314</td>
<td>810</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>400</td>
<td>1030</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>580</td>
<td>1490</td>
</tr>
</tbody>
</table>
It is emphasized that the Machinery Representative will check all fastener
tightness, and no alignments will be accepted unless all fasteners,
particularly anchor bolts are appropriately tightened.

3.1.1.14 Joint Compound

All flange joints on the pump discharges are designed for metal to metal
flanging without the use of gaskets except where gaskets are specifically
noted. Joint compound shall be used and shall be "No. 2 Permatex" (black)
or approved equal. Apply compound liberally before the final makeup of
the joint. A graphite impregnated, 3/16-inch diameter string packing
shall be placed on the flange faces as directed.

3.1.1.15 Painting

In general, all pipes shall be sandblasted and coated with a system of
coal-tar epoxy. See Section 09 97 02.01 12, PAINTING: COAL TAR EPOXY
SYSTEM.

3.1.1.16 Repair of Coating at Weld Joints

After field welding has been completed, the Contractor shall field
sandblast the interior and exterior of all piping at joints. The cleaned
metal and adjacent shop coating shall be solvent cleaned with special
solvents and then coated using the same materials, number of coats, and
placement method required for shop coating.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Government Representative will conduct field inspections and witness
field tests specified in this section. The Contractor shall perform field
tests, and provide labor, equipment, and incidentals required for testing,
extcept that water and electric power needed for field tests will be
furnished. The Contractor shall produce evidence, when required, that any
item of work has been constructed in accordance with the drawings and
specifications.

3.2.2 Testing Procedure

Test steel in accordance with applicable requirements of AWWA C600 for
hydrostatic testing. Repair of welded joints to stop leakage shall be
done by welding only.

3.2.3 Special Testing Requirements

For leakage test, use a hydrostatic pressure not less than the maximum
working pressure of the system. Leakage test may be performed at the same
time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of steel discharge pipe, and
appurtenances, all debris and surplus materials resulting from the work
shall be removed.

-- End of Section --
PART 1 GENERAL

1.1 SCOPE
   1.1.1 Special Instructions
1.2 MEASUREMENT AND PAYMENT
1.3 REFERENCES
1.4 SUBMITTALS
1.5 DELIVERY, STORAGE, AND HANDLING
   1.5.1 Delivery and Storage
   1.5.2 Handling
      1.5.2.1 High Density Polyethylene Pipe (HDPE) and Accessories

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS
   2.1.1 HDPE Pipe Materials
   2.1.2 Valves, Fire Hydrants, and Other Water Main Accessories
      2.1.2.1 Valves
      2.1.2.2 Water Valve Manholes
      2.1.2.3 Hydrants
2.2 WATER SERVICE LINE MATERIALS
   2.2.1 Disinfection
   2.3 GRANULAR BEDDING AND BACKFILL MATERIAL
   2.4 MATERIAL LIST AND PRODUCT DATA

PART 3 EXECUTION

3.1 INSTALLATION
   3.1.1 General
   3.1.2 Existing Utilities and Existing Water Lines
   3.1.3 Excavation
   3.1.4 Bedding
   3.1.5 Laying Pipe
   3.1.6 Inspection and Testing of Pipe, Linings, and Coating
   3.1.7 Water Valve Manholes
   3.1.8 Backfilling
   3.1.9 Pipe Supports
3.2 HYDROSTATIC TESTING
   3.2.1 Testing
   3.2.2 Testing Procedure
3.3 CHLORINATION
3.4 TIE-IN TO EXISTING MAIN

-- End of Section Table of Contents --
1.1 SCOPE

This section covers furnishing all plant, labor, material, supervision, equipment and operations necessary for installing new HDPE water pipe and tie-in to existing water main hot tapping (if used), new valves, new manholes, offsets, fire hydrants, etc. as required, in accordance with contract drawings and these specifications.

1.1.1 Special Instructions

The St. John The Baptist Parish will be responsible for the closure of all water valves. The Contractor shall contact the Government Representative in advance of performing this work. Valves shall not be closed more than eight (8) consecutive hours for water line tie-ins for sizes up to 12-inches in diameter.

The location of existing utilities shown on the drawings is approximate. The Contractor shall verify the elevation of all existing utilities prior to the start of work, and shall be responsible for any negligence on his part in protecting all utilities.

All water facilities installed by the Contractor will be subject to the approval of the Government Representative and St. John The Baptist Parish.

Prior to making tie-in, the Contractor shall notify residents in writing 24 hours in advance of interruption of service.

The Contractor has the option to make the tie-in to existing water main by hot tapping if the existing main cannot be taken off service. The Contractor shall coordinate with the Parish in advance.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (2010; Addenda 2011) Hypochlorites
AWWA B301 (2010) Liquid Chlorine
AWWA C200 (2012) Steel Water Pipe – 6 In. (150 mm) and Larger
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AWWA C214</td>
<td>(2007; Addenda 2010) Tape Coating Systems for the Exterior of Steel Water Pipelines</td>
</tr>
<tr>
<td>AWWA C651</td>
<td>(2005; Errata 2005) Standard for Disinfecting Water Mains</td>
</tr>
</tbody>
</table>

**ASTM INTERNATIONAL (ASTM)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ASTM D1603</td>
<td>(2012) Carbon Black Content in Olefin Plastics</td>
</tr>
<tr>
<td>ASTM D698</td>
<td>(2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))</td>
</tr>
</tbody>
</table>
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

The Contractor shall record existing conditions of actual location of water main, valves, connections and invert elevations, and discovery of uncharted utilities.

SD-03 Product Data

Material List

Product Data; G

The Contractor shall submit, to the Government Representative material list. It should include a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site. Provide product data for HDPE water pipe, fittings, valves, valve boxes or manholes, fire hydrants, manhole castings and covers, hot tapping sleeve (if used) and all other pertinent material and procedures.

SD-05 Design Data; G

Design data of HDPE water piping.

SD-06 Test Reports

Testing Procedures; G

Test Results; G

The Contractor shall furnish testing procedures and test results for the pressure testing of the water mains and the results of the pressure test, along with corrective actions taken, to the Government Representative.

SD-07 Certificates

Materials; G

Certified copies of test reports demonstrating conformance to applicable material specifications shall be delivered to the
Government Representative before material is installed. Material shall include all piping; valves; fire hydrants.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for HDPE water pipe

SD-11 Closeout Submittals

As-built Drawings;

Prior to final inspection and testing of the system, the Contractor shall submit to the Government Representative and St. John The Baptist Parish As-built drawings, showing any change in line or grade from the original drawings and location of tie-in and valves.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store HDPE, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and fire hydrants free of dirt and debris.

1.5.2 Handling

Handle pipe, valves, fire hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.2.1 High Density Polyethylene Pipe (HDPE) and Accessories

Handle HDPE pipe and accessories in accordance with manufacturer's recommendations.
PART 2  PRODUCTS

2.1  WATER DISTRIBUTION MAIN MATERIALS

2.1.1  HDPE Pipe Materials

a)  All HDPE Pipe shall be manufactured from new materials meeting the physical requirements shown in Table 1 of this section.

b)  All solid HDPE pipe shall be 8-inch diameter SDR 11 with smooth interior walls minimum pressure rating of 150 psi, minimum wall, thickness of 0.780 inches.

c)  All HDPE pipe having an outside diameter 4 inches and larger shall meet the requirements of ASTM F714.

d)  Visible defects, such as cracks, creases, crazing, non-uniformly pigmented areas, or undispersed raw materials shall not be acceptable and will result in rejection of the pipe by the Government Representative.

e)  All HDPE pipe fittings shall be in accordance with ASTM D3261 and shall be manufactured by the Manufacturer of the HDPE pipe supplied for the project and shall be pressure rated to match the system piping. The fittings shall be manufactured from the same materials as the pipe itself. The butt fusion outlets of fittings shall be machined to the same SDR as the system piping to which they are to be fused.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>VALUE</th>
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<td>----</td>
<td>PE 3408</td>
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<td>----</td>
<td>345464 C</td>
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<tr>
<td>UV Stabilizer</td>
<td>ASTM D1603</td>
<td>% Carbon Black</td>
<td>2 – 3%</td>
</tr>
</tbody>
</table>

2.1.2  Valves, Fire Hydrants, and Other Water Main Accessories

2.1.2.1  Valves

Gate valve shall be in accordance with the Parish standards. Valves shall
River Re-Introduction Into Maurepas Swamp

turn clockwise to open. All valves shall be installed in manholes.

2.1.2.2 Water Valve Manholes

Manholes and covers shall conform to the Parish standards.

2.1.2.3 Hydrants

Fire Hydrants shall be five (5) inch Breakaway Fire Hydrants with bronze trim or American Darling Fire Hydrant B-62-B. Installation of the Fire Hydrant, 6 inch ductile iron fire hydrant lead, restraints, and blocking as required by the Parish standards.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.3 GRANULAR BEDDING AND BACKFILL MATERIAL

Bedding and backfill for water mains shall be compacted sand. The sand shall be granular material conforming to the following gradation:

<table>
<thead>
<tr>
<th>U.S. Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 40</td>
<td>65-100</td>
</tr>
<tr>
<td>No. 200</td>
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</table>

2.4 MATERIAL LIST AND PRODUCT DATA

The Contractor shall submit to the Government Representative for approval design data of HDPE water piping, a material list and product data, for all water pipe including valves, valve boxes, fire hydrants, manholes, manhole castings and covers, and all other pertinent material and procedures as specified in this section and per the Parish standards.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

The Contractor shall:

(1) Verify existing conditions as shown on the contract drawings.

(2) Verify that existing water main size, location, and elevation.

(3) Notify the Government Representative in writing a minimum of three (3) working days and not more than ten (10) working days in advance of beginning construction of the water pipe.

(4) Make all tie-ins to the existing water main and provide all material for tie-in as shown on the plans and in accordance with the
Parish standards. Tie-is shall only be made once the chlorination testing process has been approved. The Parish will close valves, witness pressure tests and perform chlorination of water pipe.

(5) Interrupt service only to tie-in new HDPE pipe to existing water main. The Contractor shall obtain approval from the Government Representative prior to making the tie-in, and shall work continuously until completion of tie-in and water services are restored. Water services will not be interrupted until all crews and equipment are on-site with the connection exposed, and prepared to begin the tie-in. In addition, the Contractor shall show proof that the Parish, Fire Department and affected residents have been notified 24 hours in advance of any interruption of service. Tie-is to existing water main may also need to be performed during low service hours, over night or weekends to minimize disruption to service.

3.1.2 Existing Utilities and Existing Water Lines

The locations of existing utilities shown on the drawings are approximate. The Contractor shall verify the location of water main and adjacent utilities in the field and shall protect them from any damage.

3.1.3 Excavation

Excavate pipe trench to the dimensions as shown on the drawings, and hand trim excavation for accurate placement of pipe to elevations indicated. Excavation shall be open cuts with vertical sides using sheeting and bracing as required. All sheeting and bracing for excavation shall be in accordance with EM 385-1-1.

3.1.4 Bedding

The trench bottom shall be relatively smooth and shall be free from roots, rocks, etc. The pipe shall be laid on a smooth bed of sand to the depth shown on the drawings for the full width of the trench. The sand shall be spread in loose lifts not to exceed eight (8) inches and shall be compacted by mechanical vibrating equipment to at least 95 percent laboratory maximum density (dry) as determined by ASTM D698. Density tests shall be one (1) per lift per one hundred (100) feet of trench.

3.1.5 Laying Pipe

Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those pipes damaged during placement shall be removed and replaced. All pipe shall be sound and clean before laying. When laying is not in progress, for any reason, the open ends of the pipe shall be closed by watertight plug or other approved means. Proper alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by manufacturer.

3.1.6 Inspection and Testing of Pipe, Linings, and Coating

The Government will designate a Testing Laboratory to inspect and test the materials and workmanship of the pipes and specials at their fabricating site. The testing of the pipe by the Laboratory selected by the Government does not relieve the Contractor of his obligation in conforming to the
specifications. The pipe can be rejected by the Government Representative at the installation site if it deviates from the allowable tolerances of the specifications. The inspection and testing of the pipe and lining and coating shall be in accordance with the applicable provisions of AWWA C200, AWWA C210, AWWA C214 and AWWA C209.

3.1.7 Water Valve Manholes

Manholes and covers shall be in accordance with the Parish standards.

3.1.8 Backfilling

After the pipe has been installed, the trench shall be backfilled with sand to finished grade. Special care should be given in placing and consolidating the sand under the pipe haunches to provide adequate side support to the pipe while avoiding displacement and misalignment. The remainder of the trench shall be spread in loose lifts not to exceed eight (8) inches and shall be compacted by mechanical vibrating equipment to at least 95 percent laboratory maximum density (dry) as determined by ASTM D698. Density tests shall be one (1) per lift per one hundred (100) feet of trench. The Contractor shall be responsible for the cleanliness of the main and transmission line at all times until final acceptance of the work by the Parish. At the end of each day's work, the Contractor must provide an approved temporary water-tight test plug at each open end. When work is resumed, the trench must be free of water and dirt before the plug is removed. The maximum length that any pipe trench may be open at any time shall be one hundred (100) feet. By the close of each workday, all open trenches shall be completely backfilled.

3.1.9 Pipe Supports

The Contractor shall provide adequate temporary support to the existing water main during construction. There is no separate payment for this work and is incidental to the applicable bid item.

3.2 HYDROSTATIC TESTING

3.2.1 Testing

When the particular waterline length or portion thereof has been installed and all apparent defects have been repaired, the Contractor shall make a hydrostatic test of the pipe. He shall provide all equipment and all labor required for filling and emptying the pipe, measuring the pressure and leakage. The Government will furnish the water free of charge. The Contractor shall submit testing procedures and test results to the Government Representative.

3.2.2 Testing Procedure

All testing shall be done in accordance with the Parish standards. Each pipe shall be filled from adjacent hydrants or from other sources of supply where hydrants are not available. The Contractor shall provide connections and install the material necessary to fill and vent the line. The Contractor shall also provide connections for test gauges. The Contractor's test setup shall include provisions for the Parish to install their own pressure gage so that the Contractor's pressure readings can be verified. When the pipe is completely filled with water to the satisfaction of the Government Representative, the Contractor shall close the air cocks. All new and/or modified segments of the water distribution
system shall be tested to 100 p.s.i. This pressure shall be maintained for a period of two (2) hours with no discernible pressure loss. Leaks shall be repaired by removing and replacing faulty sections. All leaks which are discovered during the leakage test or tests, shall be repaired by and at the expense of the Contractor.

3.3 CHLORINATION

Chlorination of the water main shall be performed by the Parish or under their direct supervision. Prior to commencement of the testing and subsequent chlorination, the Contractor shall have provided and installed the materials as required by the Parish. The chlorination shall comply with AWWA C651. The Contractor shall flush the water pipe prior to the chlorination. Flushing shall be done at flow rates sufficient to provide a velocity in the water mains of at least 2.5 feet per second. The Contractor will be responsible for the cleanliness of the water pipe at all times. The Contractor shall notify the Parish, one (1) week in advance of the desired chlorination date. The Parish's forces will require four (4) working days prior notice in order to conduct the test. The Parish will need:

The Parish will perform the normal chlorination of the water pipes at no cost to the Contractor. If it is determined that the Contractor has not taken the proper precautionary measures to prevent contamination, the Parish's personnel will cease operation until the system is flushed and made clean by the Contractor. Any additional cost incurred by this added chlorination will be assessed and paid by the Contractor. Only after satisfactory pressure testing and disinfection (chlorination) is completed can the water main segment be tied into the existing water distribution system. Under no circumstances will the Contractor be allowed to make a tie-in to the existing water distribution system without direct supervision of the Government Representative and the Parish.

3.4 TIE-IN TO EXISTING MAIN

When the Contractor has completed a successful hydrostatic test and the Parish has completed chlorination operations, the Contractor shall make the tie-in to the existing mains. Tie-ins shall be performed within 72 hours of notification of passing the chlorination test. All pipe used in the tie-in shall be thoroughly cleaned and swabbed with an HTH chlorine compound solution, as recommended by Section 10 of AWWA C651. The Contractor shall furnish all labor, materials and equipment for making the connections to the existing systems as shown on the drawings. Before the water service is interrupted, the Contractor shall:

(1) Have sufficient materials, equipment and manpower available at the project site to complete all tie-ins.

(2) After uncovering the existing mains in this area and prior to shut-down of systems, the Contractor shall verify that all materials on hand will meet the needs of the task.

(3) Notify the Parish in writing one (1) week in advance of this interruption of service.

(4) Coordinate closure of all valves in the system with the Parish prior to the Contractor's de-watering of the system. The Parish will close all valves.
(5) Provide hot tapping materials (if used) and equipment at point of tie-ins, as required.

(6) The Contractor shall submit to the Government Representative and the Parish as-built drawings prior to final inspection.

(7) The Contractor shall keep the excavation free of water at the tie-in locations. The Contractor shall determine and provide sufficient pumping capacity to remove from the excavation the water coming from existing main between the closed valves.

After tie-in is complete, the new line shall be refilled under normal Parish water main pressure. The tie-in piping will then be visually inspected for leaks and any leaks disclosed will be repaired by the Contractor at his own expense. The Contractor shall expose the existing water main at tie-in locations and verify the type, size, location, and elevation of the existing facilities, prior to fabricating or installing any new pipe. Tie-in shall be worked simultaneously. Once a tie-in is started, the Contractor shall work continuously until it is completed. The Contractor may need to make some water house connections or water main tie-ins during low service times which may be overnight or weekends.

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1.2 REFERENCES
1.3 SUBMITTALS
1.4 DELIVERY, STORAGE, AND HANDLING
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   1.4.2 Handling

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SECTION 33 40 00
STORM DRAINAGE UTILITIES
02/10

PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)


AASHTO M 294 (2011) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

ASTM INTERNATIONAL (ASTM)


Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications


- **ASTM C1103** (2003; R 2009) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

- **ASTM C14** (2011) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe


- **ASTM C270** (2012a) Standard Specification for Mortar for Unit Masonry


- **ASTM C444** (2003; R 2009) Perforated Concrete Pipe

- **ASTM C76** (2013a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

- **ASTM C828** (2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines

- **ASTM C877** (2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

- **ASTM C924** (2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

- **ASTM C231** (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method


- **ASTM D1171** (1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

- **ASTM D1557** (2012) Standard Test Methods for Laboratory Compaction Characteristics of
Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)


ASTM D2167 (2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method


ASTM D2729 (2011) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings


ASTM F714 (2012a) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pipe for Culverts and Storm Drains;   G
Placing Pipe
Elastomeric Check Valves;   G
Submit Manufacturer's shop drawings that clearly identify valve dimensions; Flow Data, Headloss Data and Pressure Rating

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes, valves and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Government Representative. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.
1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class IV, wall B Type.

2.1.2 Corrugated Steel Pipe

ASTM A760, zinc or aluminum coated pipe of either:

a. Type I pipe with annular 2-2/3 by 1/2 inch corrugations.

b. Type IR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.3 Ductile Iron Culvert Pipe

ASTM A716.

2.1.4 Perforated Piping

2.1.4.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C444, and applicable requirements of ASTM C14.

2.1.4.2 Corrugated Steel Pipe

ASTM A760, Type III, zinc-coated.

2.1.4.3 PVC Pipe

ASTM D2729.

2.1.5 PVC Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.5.1 Type PSM PVC Pipe

ASTM D3034, Type PSM, maximum SDR 35, produced from PVC certified by the compander as meeting the requirements of ASTM D1784, minimum cell class 12454-B.
2.1.5.2 Profile PVC Pipe

ASTM F794, Series 46, produced from PVC certified by the compounding as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.5.3 Smooth Wall PVC Pipe

ASTM F679 produced from PVC certified by the compounding as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.5.4 Corrugated PVC Pipe

ASTM F949 produced from PVC certified by the compounding as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.6 PE Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D3350.

2.1.6.1 Smooth Wall PE Pipe

ASTM F714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

2.1.6.2 Corrugated PE Pipe

AASHTO M 294, Type S or C. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

<table>
<thead>
<tr>
<th>Nominal Size (in.)</th>
<th>Minimum Wall Area (square in/ft)</th>
<th>Minimum Moment of Inertia of Wall Section (in to the 4th/in)</th>
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</thead>
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<tr>
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</table>

2.1.6.3 Profile Wall PE Pipe

ASTM F894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 334433C. Pipe walls shall have the following properties:
Minimum Moment Of Inertia of Wall Section (in to the 4th/in)

<table>
<thead>
<tr>
<th>Nominal Size (in.)</th>
<th>Minimum Wall Area (square in/ft)</th>
<th>Cell Class</th>
<th>Cell Class</th>
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</tbody>
</table>

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements specified under Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the
ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Joints

2.3.3.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph "HYDROSTATIC TEST ON WATERTIGHT JOINTS". Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Government Representative before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.3.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.3.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph "HYDROSTATIC TEST ON WATERTIGHT JOINTS".

2.3.3.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.3.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.3.6 Corrugated PE Plastic Pipe

Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477.

2.3.3.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F894.

2.3.3.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.3.4 Elastomeric Check Valve

A. Check Valves are to be all rubber and the flow operated check type with slip-in cuff connection. The entire check valve shall be ply reinforced throughout the body, disc and bill, which is cured and vulcanized into a one-piece unibody construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure any component of the valve to a valve housing. The port area of the disc shall contour into a circumferential sealing area concentric with the pipe which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe inside diameter. Once installed, the Check Valve shall not protrude beyond the face of the structure or end of the pipe.

B. The outside diameter of the upstream and downstream sections of the valve must be circumferentially in contact with the inside diameter of the pipe.

C. Slip-in style valves shall be furnished with a set of stainless steel expansion clamps. The clamps, which will secure the valve in place, shall be installed in the upstream or downstream cuff of the valve, depending on installation orientation, and shall expand outwards by means of a turnbuckle. Each band shall be pre-drilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions.

D. All elastomeric check valves shall be CMC slip-in checkmate valves as manufactured by Tideflex Technologies or approved equal.
2.4 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.4.1 Concrete, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C443. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D3212.

2.4.2 Corrugated Steel and Aluminum Pipe

A hydrostatic test shall be made on the watertight joint system or coupling band type proposed. The moment strength required of the joint is expressed as 15 percent of the calculated moment capacity of the pipe on a transverse section remote from the joint by the AASHTO HB-17 (Division II, Section 26). The pipe shall be supported for the hydrostatic test with the joint located at the point which develops 15 percent of the moment capacity of the pipe based on the allowable span in feet for the pipe flowing full or 40,000 foot-pounds, whichever is less. Performance requirements shall be met at an internal hydrostatic pressure of 10 psi, for a 10 minute period for both annular corrugated metal pipe and helical corrugated metal pipe with factory reformed ends.

2.5 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of as indicated.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 23 00.00 12 EXCAVATION and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Government Representative, is unexpectedly
encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph "BACKFILLING". When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Corrugated Metal Pipe

Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A798. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A807.

3.2.3 Ductile Iron and Cast-Iron Pipe

Bedding for ductile iron and cast-iron pipe shall be as shown on the drawings.

3.2.4 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the
Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

<table>
<thead>
<tr>
<th>TYPE OF PIPE</th>
<th>MAXIMUM ALLOWABLE DEFLECTION (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrugated Steel</td>
<td>5</td>
</tr>
<tr>
<td>Ductile Iron Culvert</td>
<td>3</td>
</tr>
<tr>
<td>Plastic (PVC &amp; HDPE)</td>
<td>5</td>
</tr>
</tbody>
</table>

Note post installation requirements of paragraph "Deflection Testing" in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated Metal Pipe and Pipe Arch

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides. Part paved pipe shall be installed so that the centerline of bituminous pavement in the pipe, indicated by suitable markings on the top at each end of the pipe sections, coincides with the specified alignment of pipe. Fully paved steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243. Interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings. During transportation and installation, pipe or pipe arch and coupling bands shall be handled with care to preclude damage to the coating, paving or lining. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, paving or lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

3.4 BACKFILLING

3.4.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of
pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 6 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Government Representative, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.4.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.4.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.4.4 Compaction

3.4.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.4.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking
areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.4.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph "Calibration" of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Government Representative. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.5 PIPELINE TESTING

3.5.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C828. Low pressure air testing for concrete pipes shall conform to ASTM C924. Low pressure air testing for plastic pipe shall conform to ASTM F1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C828 or ASTM C924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Government Representative. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line
shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.5.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph "PLACING PIPE" above as percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel.

a. Laser Profiler Inspection: If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection, and replace with new pipe. Initial post installation inspections of the pipe interior with laser profiling equipment shall utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, visual inspection shall be completed of the pipe interior.

b. Pull-Through Device Inspection: Pass the pull-through device through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show excess allowable deflections of the average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions. Pull-through device: The mandrel shall be rigid, nonadjustable having a minimum of 9 fins, including pulling rings at each end, engraved with the nominal pipe size and mandrel outside diameter. The mandrel shall be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum Alloy, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by manufacturer. When mandrels are utilized to verify deflection of flexible pipe products, the Government will verify the mandrel OD through the use of proving rings that are manufactured with an opening that is certified to be as shown above.
c. Deflection measuring device: Shall be approved by the Government Representative prior to use.

d. Warranty period test: Pipe found to have a deflection of greater than allowable deflection in paragraph "PLACING PIPE" above, just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection. Inspect 100 percent of all pipe systems under the travel lanes, including curb and gutter. Random inspections of the remaining pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. Inspections shall be made, depending on the pipe size, with video camera or visual observations. In addition, for flexible pipe installations, perform deflection testing on 100 percent of all pipes under the travel lanes, including curb and gutter, with either a laser profiler or 9-fin mandrel. For flexible pipe, random deflection inspections of the pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. When mandrels are utilized to verify deflection of flexible pipe products during the final post installation inspection, the Government will verify the mandrel OD through the use of proving rings.

3.5.3 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment. One hundred percent of all flexible pipes (HDPE, PVC, CMP) shall be checked for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and final post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.6 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

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PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, equipment, labor and materials, and performing all operations in connection with the installation of new gear box in accordance with these specifications and applicable drawings.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10, MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11  (1990; R 2008) Load Ratings and Fatigue Life for Roller Bearings

ABMA 9  (1990; R 2008) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 6013  (2006) Standard for Industrial Enclosed Gear Drives

AGMA 6025  (1998d; R 2004) Sound for Enclosed Helical, Herringbone and Spiral Bevel Gear Drives

AGMA 6123  (2006b) Design Manual for Enclosed Epicyclic Gear Drives

ASME INTERNATIONAL (ASME)


INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

1.4 SYSTEM DESCRIPTION

1.4.1 General Product Requirements

The speed reducer shall be designed and manufactured by a firm that is regularly engaged in the manufacture of speed reducers of the type utilized for these installations. The reducer shall display the certified manufacturer's AGMA insignia as evidence of conformance to these standards. The nameplate shall bear the manufacturer's name, model designation, serial number, unit rating, application factor, reduction ratio, and other applicable information. The speed reducer shall be single reduction spiral bevel gear type equipped with thrust bearings to make the speed reducer suitable for use with a vertical impeller pump. Where upthrust is possible during pump startup or shutdown, the thrust bearing shall be designed to resist this load. The speed reducer shall be able to withstand all of the specified operating conditions without damage. A backstop shall be provided to prevent reverse rotation of the pump. The gear reducer shall conform to the requirements of AGMA 6013 or AGMA 6123 as applicable. The speed reducer shall be air-cooled and self contained.

1.4.2 Design Conditions

1.4.2.1 Operating Conditions

Obtain the operating conditions from the pump and prime mover suppliers. Operating conditions which shall be considered include as a minimum: maximum input power, engine speed, speed reducer ratio, maximum pump reverse overspeed, low-speed shaft downward thrust including weight, low-speed shaft momentary upward thrust during startup or shutdown, high-speed shaft direction of rotation, low-speed shaft direction of rotation, overhung load, maximum engine overload torque transmitted through the clutch, and the reverse torque load on the backstop.

1.4.2.2 Runaway

The speed reducer shall be designed to withstand backstop failure and maximum pump reverse runaway speed for a period of 30 minutes.

1.4.2.3 Critical Speeds

Dynamic analysis of the pump, reducer, and engine assembly shall be performed by the pump manufacturer. The reducer manufacturer shall coordinate with the pump manufacturer in performing the dynamic analysis. The reducer manufacturer shall make any design modifications to the reducer which are necessary to avoid resonances in the system. A torsional or lateral natural frequency within 25 percent of normal operating speed of any shaft or gear mesh frequency is unacceptable.
1.4.3 Arrangement

The arrangement shall use a true hollow low-speed shaft where the pump shaft passes concentrically through the reducer shaft allowing finite impeller elevation adjustment. The speed reducer input shaft shall be connected to the engine with two universal joints and an intermediate shaft. Ensure compatibility and fit of the reducer high- and low-speed shafts with that of the pump and prime mover. The speed reducer mounting shall be designed to permit removal of the reducer and reinstallation without requiring realignment of the reducer and shafting. Before assembly, each gear and shaft assembly shall be dynamically balanced.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Speed Reducer; G
Lubrication System; G
Instrumentation; G

Detail drawings of sufficient size for easy reading and consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Show on the drawings proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of work including clearances for maintenance and operation.

SD-03 Product Data

System Description; G
Bearings
Gears
Shafts
Backstop
Housing
Lubrication System
Instrumentation; G
Speed Reducers; G
Lubricant

Complete computations, design loads, and catalog data.

SD-06 Test Reports

Shop Testing; G

A shop test report fully documenting the test.

Field Testing; G
A field test report documenting all data for load and speed measurement, lubrication oil temperature and flow, gear contact patterns, adjustment of component settings, and otherwise showing compliance with specified performance criteria.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual; G

Operation and Maintenance Manual which provides detailed startup and operating procedures, lubrication instructions, installation and alignment procedures, routine maintenance requirements and procedures, complete detailed procedures for disassembly and assembly of the reducer, parts list for all parts detailed, assembly drawings of the reducer showing all parts, suppliers for all parts, settings and adjustment for protective devices, and a list of all tools, handling devices, and spare parts furnished.

1.6 DELIVERY, STORAGE, AND HANDLING

Material and equipment shall be protected from weather, humidity, temperature variation, dirt, dust, and other contaminants during delivery and storage.

1.7 EXTRA MATERIALS

Submit the following:

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of gear reducers for vertical pump drives and that essentially duplicate products which have been in prior satisfactory use for at least two (2) years prior to bid opening. All products shall be new. The reducer assembly shall be rated in accordance with AGMA 6013 or AGMA 6123 as applicable. The unit rating shall be equal to or exceed the maximum input power times an application factor. The application factor shall be 1.5 for reducers driven by natural gas engines.

2.2 BEARINGS

2.2.1 Thrust Bearings

Provide thrust bearings which are either hydrodynamic fluid film type or antifriction type. Antifriction thrust bearings shall be either tapered roller or spherical roller type. The thrust bearing shall be sized for the pump thrust plus the weight of the impeller and shaft. The thrust bearing size and arrangement shall be coordinated with the pump supplier. The bearings shall be able to sustain continuous operational load as well as startup and shutdown loads. Hydrodynamic fluid film thrust bearings shall use pivoted segmental shoes with the babbitted face surfaced as recommended by the bearing manufacturer to maintain an optimum oil film.

2.2.2 Radial Bearings

Radial bearings for spiral bevel and parallel shaft reducers shall be
2.2.3 Hydrodynamic Fluid Film Bearings

Design the bearings to have a minimum oil film thickness of 0.0005 inch under the most severe operating conditions. The bearing loads shall not exceed 350 psi for the maximum load. Where hydrodynamic fluid film thrust bearings are used, suitable hydrostatic lift provisions shall be made if required to prevent bearing damage during startup. Thrust bearings shall be provided with either spring loaded or embedded instrumentation to monitor operating temperatures.

2.2.4 Antifriction Bearings

Antifriction bearings shall be rated for an L-10 life of 100,000 hours at the operating load of the reducer. Ball bearing load ratings shall conform to ABMA 9. Roller bearing load ratings shall conform to ABMA 11.

2.3 GEARS

Right angle gearing shall be of the spiral bevel design. Spiral bevel, helical, and double helical gears shall be gas nitrided or carburized, hardened and ground. The pinion or gear of each helical set shall be crowned to eliminate end loading. For helical gears, standard normal diametral pitches shall be used. In addition to rating the gears according to AGMA 6013 or AGMA 6123 as applicable, gear stresses shall not exceed 80 percent of yield strength for any overload, or engine overload condition.

2.4 SHAFTS

Each shaft shall be heat treated alloy steel. Input shaft size and configuration shall be compatible with the engine and clutch. Output shaft size and configuration shall be compatible with the pump. Welded shafts are not acceptable.

2.5 UNIVERSAL JOINTS

The speed reducer shall be connected to the engine by input shaft with universal joints. The universal joints shall have a service factor of 2 based on maximum rated load. In addition, at maximum overload conditions, stresses shall not exceed 80 percent of yield strength. Universal joints shall have forged steel yokes and spiders and shall have sealed needle roller bearings. Universal joints shall be installed in pairs. The angles between each shaft and the intermediate shaft shall be equal and shall not exceed the manufacturer's recommendation. The driving pins on the yokes attached to the intermediate shaft shall be set parallel to each other. The universal joints shall be dynamically balanced to AGMA balance classification 7 or better and shall be grease lubricated unless self-lubricated.

2.6 BACKSTOPS

Provide a backstop on the output shaft to prevent reverse rotation of the pump. For double reduction reducers, the backstop may be mounted on the output or intermediate shaft. Size the backstop for the resulting torque at the reducer during maximum reverse flow at pump and a service factor of 2.0 shall be applied to the manufacturer's published rating. In addition the backstop shall be suitable for continuous operation at engine idle.
speed of 800 rpm. The backstop shall be of a type with cylindrical rollers on inclined cam planes or drop-pin type. The backstop shall operate at a temperature of less than 160 degrees F under all operating conditions with an ambient temperature up to 100 degrees F. The backstop shall be provided with a circulating oil lubrication system and shall have sufficient flow rate to provide the required cooling. The lubrication system may be part of the gear reducer lubrication system.

2.7 HOUSING

2.7.1 General

The housing shall be cast or fabricated steel, stress relieved prior to machining, and reinforced to carry all applied loads and to maintain gear alignment. The housing bottom shall be machined. The interior of the reducer shall be painted with an oil compatible coating. The exterior shall be painted with the manufacturer's standard coating system. Color shall be light gray. The housing shall have an oil fill connection and a drain connection with a magnetic plug. Lifting lugs shall be provided for lifting the entire reducer assembly and any subassembly or component which cannot be lifted using web slings.

2.7.2 Seals

Vertical down output shafts shall have a drywell design seal. The input shaft shall have a lip seal to prevent leakage of oil and exclude dirt. Lip seals shall utilize hardened steel wear sleeves to preclude shaft repair or replacement if the seal wears the shaft.

2.7.3 Inspection Covers

The housing shall have inspection holes with cover plates located above the maximum oil level to permit viewing of gear teeth allowing evaluation of the contact patterns of each gear mesh and to allow inspection of internal features of the lubrication system.

2.8 LUBRICATION SYSTEM

2.8.1 General

The speed reducer shall be provided with an oil lubrication system that will provide continuous lubrication to the gears, bearings, and oil lubricated-type backstop. The system shall consist of an oil circulating pump, oil-to-air heat exchanger, piping, filters, and controls. Each reducer shall be provided with its own system. The oil circulating pump shall be driven directly from the speed reducer shaft. The maximum oil sump temperature at rated speed and load shall be 160 degrees F at an ambient temperature of 100 degrees F. If a hydrodynamic thrust bearing is used, its lubrication system may be part of the gear reducer lubrication system, or a separate lubrication system may be provided.

2.8.2 Oil Pumps

The oil pumps shall be positive displacement type. Each pump shall have a relief valve which discharges to the sump. The pump shall be reversible so it continues to function during a runaway condition.
2.8.3 Oil and Breather Filters

The lubricating system shall have two oil filters on the pump outlet side. One filter shall be for removing particles and the other for water removal. The filter for particles shall have a Beta rating of B6 greater than 75 at 60 psi differential tested in accordance with ISO 16889. The reducer manufacturer may propose an alternate Beta rating by submitting proof that B6 greater than 75 is unsuitable for the lubricant to be used. Each filter shall incorporate an oil-filled differential pressure gauge to indicate the pressure drop across the filter. The filter shall have an internal magnetic element. The water removal filter shall maintain a water content in the oil of no greater than 200 ppm. All filter assemblies shall be sized so the pressure drop across the clean filter is no greater than 4 psi. The particle filter shall be sized to avoid bypass at a startup oil temperature of 80 degrees F. Filters shall have a bypass setting of 45 to 60 psi. Element collapse rating shall not be less than 150 psi. The breather filter shall have a Beta rating of B6 greater than 75 and a desiccant chamber to remove water.

2.8.4 Heat Exchanger (Optional)

The heat exchanger shall be an oil-to-air type with size based upon a maximum ambient temperature of 100 degrees F. Heat exchanger tubes and fins shall be copper or copper alloy. Working pressure shall exceed the oil pump working pressure. The heat exchanger shall withstand a test pressure of 150 percent of the design pressure held for a period of 4 hours during which time the heat exchanger shall be checked for leakage. Any leakage shall be cause for rejection. The oil-to-air heat exchanger system shall include a fan, motor, and controls for maintaining the specified oil temperature. The motor shall operate from the engine alternator.

2.8.5 Piping and Tubing

Oil lines up to 2 inches o.d. shall be seamless steel tubing with 37 degree flare or flareless fittings. Where pipe sizes of 2 inches and over are required, steel pipe with welded fittings shall be used. Water piping shall be copper or copper alloy with brazed or 95-5 soldered joints. All piping, tubing, and fittings shall conform to ASME B31.1. Vibration isolating tubing and piping supports shall be used. Oil tubing or ports shall be kept within the gear case where feasible. Dissimilar metals shall be electrically isolated to prevent corrosion.

2.8.6 Lubricating Oil

Lubricating oil shall be mineral oil or synthetic hydrocarbon as recommended in AGMA 6013 or AGMA 6123 for an ambient temperature range of -15 to +125 degrees F. The lubricant shall be suitable for the entire temperature range without change of lubricant. Lubricant additives shall be used as recommended by the reducer manufacturer. Lubricant shall also be suitable for use with the backstop. Lubricant used for the hydrodynamic thrust bearing shall be suitable for the bearing. Catalog data of the proposed lubricant shall be submitted for approval in accordance with paragraph "SUBMITTALS".

2.9 INSTRUMENTATION

Instrumentation for the reducer shall be supplied and installed as a complete working package, coordinated with the pump and prime mover.
supplier. All electrical work shall conform to NFPA 70. Electrical enclosures shall be NEMA 250, Type 4. An electrical termination cabinet shall be provided. Available power is 24 V, DC. The speed reducer shall have the following devices as a minimum:

a. High oil temperature switch in unit sump.
   (1) Alarm at 180 degrees F.
   (2) Shut down prime mover at 200 degrees F.
   (3) Lower settings may be used if recommended by the reducer manufacturer.

b. Oil pressure gauge.
   (1) After oil pump.
   (2) Gauges shall be oil or glycerin filled and shall have snubbers and isolation valves.

c. Thermometer. Mercury shall not be used in thermometers.
   (1) Sump
   (2) Oil line after heat exchanger
   (3) Backstop

d. Oil Level Sight Gauge, with built in reflector.

e. Resistance Temperature Detector (RTD), Hydrodynamic Thrust Bearing, if used.
   (1) Alarm at 180 degrees F.
   (2) Shut down prime mover at 200 degrees F.
   (3) Lower settings may be used if recommended by the reducer and bearing manufacturers.

f. Oil Flow Switch.
   (1) Alarm at 80 percent of design flow.
   (2) Shut down prime mover at 60 percent of design flow.

g. Vibration Switch - Alarm at 0.5 inch/sec or at baseline level recommended by the reducer manufacturer.

PART 3   EXECUTION

3.1 TESTS, INSPECTIONS, AND VERIFICATIONS

3.1.1 Shop Testing

In addition to or as part of the Contractor's normal shop testing procedure, the reducer shall be tested at rated speed, no load to check for potential problems which shall be eliminated prior to field testing.
Gear contact patterns, sound level, lubrication and cooling, and all other operational characteristics shall be checked. The sound pressure level of the speed reducer and prime mover used in the shop test shall not exceed 90 dBA measured at a distance of 3 feet from the equipment. Sound shall be measured in accordance with AGMA 6025. Provide any preventative measures to control background noise. Notify the Government Representative two (2) weeks prior to performing the shop test.

3.1.2 Installation

Install the speed reducer and ensure all features and systems are operational. The speed reducer shall be installed under the supervision of the reducer manufacturer's representative. The speed reducer shall be designed for ease of handling and installation. All necessary lifting devices, attachments, and special tools required for maintenance shall be provided by the Contractor. Submit an Operation and Maintenance Manual as specified in the Submittals paragraph.

3.1.3 Field Testing

Field test the speed reducer at rated speed and load to demonstrate that reducer operation, lubrication, cooling, and instrumentation meet contract requirements. The duration of the testing shall be sufficient to develop verifiable gear contact patterns and at the minimum for as long as the pump operational test. Gear contact patterns shall be inspected and shown to the Government Representative. Gear contact patterns for helical gears shall be at least 70 percent of face width. Spiral bevel gears shall have a central toe contact pattern with contact of 50 percent of face width at full load. Gear contact patterns shall be photographed and included as part of the field test report. The report shall document all data collected for load and speed measurement, lubrication, oil temperature and flow, ambient temperature, gear contact patterns, and any other data required to show compliance with specifications. Should there be insufficient water available to perform the test, the Government Representative may delay the test for up to 9 months or waive the test.
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PART 1 GENERAL

1.1 SUMMARY

This section defines the requirements for pipe, piping components, and valves as related to fuel distribution systems (non-aviation type). Provide the entire fuel distribution system as a complete and fully operational system. Size, select, construct, and install equipment and system components to operate together as a complete system. Substitutions of functions specified herein will not be acceptable. Coordinate the work of the system manufacturer's service personnel during construction, testing, calibration, and acceptance of the system. Equipment and piping specified herein shall be designed to handle a working pressure of 275 psig at 100 deg F. Equipment specified herein shall be compatible with the fuel to be handled.

1.1.1 Related Sections

1.1.1.1 Welding

Welding activities for pipe and piping components shall be in accordance with Section 05 05 23 WELDING, STRUCTURAL.

1.1.1.2 Concrete Manholes

Construct manhole of concrete in accordance with Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

1.2 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API BULL 2209 (1978) Pipe Plugging Practices

API RP 1110 (2013) Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide

API RP 2003 (2008; 7th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
API RP 540 (1999; R 2004) Electrical Installations in Petroleum Processing Plants


API Spec 6D (2008; Errata 1 2008; Errata 2 2008; Errata 3 2009; Addendum 1 2009; Errata 4 2010; Errata 5 2010; Errata 6 2011; Addendum 2 2011; Addendum 3 2012) Specification for Pipeline Valves

AMERICAN WATER WORKS ASSOCIATION (AWWA)


AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding


ASME INTERNATIONAL (ASME)

ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.18 (2012) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges


ASME B16.26 (2011) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B16.34 (2013) Valves - Flanged, Threaded and Welding End


ASME B18.2.1 (2010) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2010) Standard for Square and Hex Nuts

ASME B31.3 (2012) Process Piping

ASME B40.100 (2005; R 2010) Pressure Gauges and Gauge Attachments

ASME B40.200 (2008) Thermometers, Direct Reading and Remote Reading

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII—Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A182 (2012a) Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

ASTM A193 (2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A194 (2012) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both


ASTM D3308 (2012) PTFE Resin Skived Tape

ASTM D5677 (2005; R 2010) Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type, for Aviation Jet Turbine Fuel Lines


ASTM F436 (2011) Hardened Steel Washers
ASTM F844 (2007a) Washers, Steel, Plain (Flat), Unhardened for General Use

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)


NACE INTERNATIONAL (NACE)


NACE SP0188 (1999; R 2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2011; Errata 2012) Motors and Generators


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (2012; Errata 2011; Errata 2011) Flammable and Combustible Liquids Code

NFPA 70 (2011; Errata 2 2012) National Electrical Code

NFPA 77 (2007) Recommended Practice on Static Electricity

NFPA 780 (2011) Standard for the Installation of Lightning Protection Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3275 (2009; Rev C) Sheet, Acrylonitrile Butadiene (NBR) Rubber and Non-Asbestos
Fiber Fuel and Oil Resistant

SAE J514 (2012) Hydraulic Tube Fittings

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2000; E 2004) Shop, Field, and Maintenance Painting of Steel

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50561 (Basic) Pumps, Rotary, Power-Driven, Viscous Liquids

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Grounding and Bonding
- Pipe Hangers and Supports

SD-03 Product Data

- Stainless Steel Pipe
- Exterior Containment Piping System
- Copper Piping
- Pressure Gauge
- Flexible Ball Joint
- Bellows Expansion Joint
- Swing Type Check Valve
- Ball Valve
- Plug Valve (PTFE Sleeved Tapered Type)
- Globe Valve
- Pressure Relief Valve
- Foot Valve
- Tank Overfill Prevention Valve
- Submersible Pump
- Rotary Pumps
- Pump Control Panel

SD-06 Test Reports

- Exterior Coating Holiday Test
- Final Pneumatic Test
- Hydrostatic Test
- Exterior Containment Piping Tests

SD-07 Certificates

- Contractor Qualifications
- Licensed Personnel

SD-08 Manufacturer's Instructions
Flexible Ball Joint
Bellows Expansion Joint

SD-10 Operation and Maintenance Data
Flexible Ball Joint
Bellows Expansion Joint
Swing Type Check Valve
Ball Valve
Plug Valve (PTFE Sleeved Tapered Type)
Globe Valve
Pressure Relief Valve
Foot Valve
Tank Overfill Prevention Valve
Submersible Pump
Rotary Pumps

1.5 QUALITY ASSURANCE

1.5.1 Contractor Qualifications

Each installation Contractor shall have successfully completed at least 3 projects of the same scope and the same size, or larger, within the last 6 years; demonstrate specific installation experience in regard to the specific system installation to be performed; have taken, if applicable, manufacturer's training courses on the installation of piping; and meet the licensing requirements in the state. Submit a letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed providing in the letter evidence of prior manufacturer's training and state licensing.

1.5.2 Regulatory Requirements

1.5.2.1 Licensed Personnel

Pipe installers shall be licensed/certified by the state when the state requires licensed installers.

1.6 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Government Representative. Replace damaged or defective items.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Internal parts and components of equipment, piping, piping components, and valves that could be exposed to fuel during system operation shall not be constructed of zinc coated (galvanized) metal, brass, bronze, or other copper bearing alloys. Do not install cast iron bodied valves in piping systems that could be exposed to fuel during system operation.
2.1.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products; that are of a similar material, design and workmanship; and that have been in satisfactory commercial or industrial use for a minimum 2 years prior to bid opening. The two (2) year period shall include applications of the equipment and materials under similar circumstances and of similar size. Materials and equipment shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two (2) year period. Products having less than a two (2) year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours, exclusive of the manufacturer's factory tests, can be shown.

2.1.2 Nameplates

Attach nameplates to all specified equipment, thermometers, gauges, and valves defined herein. List on each nameplate the manufacturer's name, address, contract number, component type or style, model or serial number, catalog number, capacity or size, and the system that is controlled. Construct plates of stainless steel. Install nameplates in prominent locations with nonferrous screws, nonferrous bolts, or permanent adhesive. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be the normal block style with a minimum 0.25 inch height. Accurately align all lettering on nameplates. Key the nameplates to a chart and schedule for each system. Frame charts and schedule under glass, and locate where directed near each system. Furnish two copies of each chart and schedule. Each nameplate description shall identify its function.

2.1.3 Gaskets

Provide gaskets that are factory cut from one piece of material.

2.1.3.1 Nitrile Butadiene (Buna-N)

Provide Buna-N material that conforms to SAE AMS3275.

2.1.3.2 Acrylonitrile Butadiene Rubber (NBR)

Provide NBR material that conforms to SAE AMS3275.

2.2 ELECTRICAL COMPONENTS

2.2.1 General

Provide motors, motor starters, controllers, integral disconnects, contactors, controls, and control wiring with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide switches and devices necessary for controlling and protecting electrical equipment. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Controllers and contactors shall have a maximum of 120-volt control circuits and shall have auxiliary contacts for use with the controls provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.
2.2.2 Motors

Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

2.2.3 Motor Controllers

Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hpor less and adjustable frequency drives for larger motors unless otherwise indicated.

2.2.4 Underground Wiring

Enclose underground electrical wiring in PVC coated conduit. Dielectrically isolate conduit at any steel storage tank connection.

2.2.5 Grounding and Bonding

Grounding and bonding shall be in accordance with NFPA 70, NFPA 77, NFPA 780, API RP 540, API RP 2003, IEEE 142, and IEEE 1100. Provide jumpers to overcome the insulating effects of gaskets, paints, or nonmetallic components.

2.3 FLANGED END CONNECTIONS

2.3.1 Flanges

Provide flanged end connections on equipment, fittings, piping, piping components, adapters, couplers, and valves that conform to ASME B16.5, Class 150.

2.3.1.1 Stainless Steel

Stainless steel flanges shall conform to ASTM A182, Grade F304 or F304L, forged type.

2.3.2 Flange Gaskets, Non-Isolating

Provide flange gaskets that are 1/8 inch thick and that conform to ASME B16.21, raised-face type unless otherwise indicated. Gaskets shall be constructed of Buna-N.
2.3.3 Flange Protectors

Protectors shall protect the bolts, studs, nuts, and gaskets of a flanged end connection from corrosion or damage due to exposure to the environment. Protectors shall be weather and ultraviolet (UV) resistant. Protectors shall allow for quick and easy removal and re-installation by maintenance personnel.

2.3.4 Flange Bolts, Nuts, and Washers

Bolts and nuts for pipe flanges, flanged fittings, valves and accessories shall conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified. Bolts shall be regular hexagonal type. Bolts shall be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 1 inch. Nuts shall be the hexagonal, heavy series type. Nuts shall be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 1 inch. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project no more than two full threads beyond the nuts with the bolts tightened to the required torque.

2.3.4.1 Stainless Steel Materials

Bolts shall conform to ASTM A193, Class 2, Grade 8. Nuts shall conform ASTM A194, Grade 8. Washers shall conform to ASTM F436, flat circular.

2.4 PIPE

Pipe shall meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein.

2.4.1 Stainless Steel Pipe

Provide stainless steel pipe that complies with one of the following:

a. Pipe shall conform to ASTM A312, Type TP304L, seamless only. Pipe smaller than 8 inches shall be Schedule 40S. Pipe 8 inches or larger shall be Schedule 10S.

b. Pipe shall conform to ASTM A358, Grade 304L, Class 1 or 3, longitudinally welded. Radiographically inspect 100 percent of factory longitudinal welds in accordance with ASME BPVC SEC VIII D1. Minimum pipe wall thickness shall be 0.25 inch for pipe 12 inches and smaller; 0.312 inch for pipe larger than 12 inches.

2.4.1.1 Fittings 65 mm (2-1/2 in) and Larger

Provide buttwelded type fittings that complies with one of the following:

a. Stainless steel conforming to ASTM A403, Class WP-S, Grade WP 304L, seamless only and ASME B16.9 of the same thickness as the adjoining pipe.

b. Stainless steel conforming to ASTM A403, Class WP-XX, Grade WP 304L, of wall thickness as indicated. Do not fabricate starting material by the fusion welding process without addition of filler metal. Forming will not be allowed using fusion welding process without addition of filler metal. Radiographically inspect all
factory longitudinal welds in accordance with ASME BPVC SEC VIII D1.

2.4.1.2 Fittings 50 mm (2 in) and Smaller

Socket welded type fittings, unless indicated otherwise, shall conform to ASME B16.11. Fitting materials shall be stainless steel that conforms to ASTM A182, Type F304L.

2.4.1.3 Control Piping

Piping shall be seamless, fully annealed stainless steel tubing conforming to ASTM A269, Grade TP316, with a hardness number not exceeding 80 HRB. For 1/2 inch tubing, provide a minimum 0.049 inch tubing wall thickness.

2.4.1.4 Control Piping Fittings

Fittings shall be the flareless, Type 316 stainless steel type conforming to SAE J514.

2.4.2 Exterior Containment Piping System

a. Piping system shall be the factory fabricated, double-wall type that conforms to ASME B31.3 and NFPA 30. Product pipe shall be as indicated on the drawings and as specified herein. The exterior containment pipe shall be fiberglass reinforced plastic (FRP) that conforms to ASTM D5677 except as modified herein. Containment pipe shall be chemically compatible with the type of fuel to be handled, be non-corrosive, dielectric, non-biodegradable, and resistant to attack from microbial growth. Containment piping shall be capable of withstanding a minimum 5 psi air pressure. Containment piping and supports shall be designed to allow for drainage of liquids. Containment piping shall allow for complete inspection of the product piping before the containment piping is sealed.

b. Containment piping shall be evenly separated from the product piping with pipe supports that are designed based on pipe size, pipe and fuel weight, and operating conditions. Pipe supports shall be constructed of the same material as the product pipe or FRP. Design supports so that no point loading occurs on the primary or exterior pipe. Supports shall be permanently attached to the product pipe either by tack welding or by an adhesive. Supports shall be designed and installed to allow for pipe movement of both the product piping and the exterior containment piping without causing damage to either.

2.4.3 Copper Piping

Pipe and tubing shall conform to ASTM B88, Type K or L.

2.4.3.1 Fittings and End Connections

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.
2.4.3.2 Solder

Solder shall conform to ASTM B32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B813.

2.4.3.3 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.5 PIPING COMPONENTS

Provide piping components that meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein. Pressure design class for piping components shall be Class 150 as defined in ASME B16.5.

2.5.1 Welded Nipples

Nipples shall conform to ASTM A733 or ASTM B687 and be constructed of the same material as the connecting pipe.

2.5.2 Steel Couplings

Couplings shall conform to API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.

2.5.3 Threaded Unions

Unions shall conform to ASME B16.39, Class 150. Unions materials shall conform to ASTM A312, Grade 304 or 316. Dielectric unions shall conform to dimensional, strength, and pressure requirements of ASME B16.39, Class 150. Steel parts shall be galvanized or plated. Union shall have a water-impermeable insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, union shall be able to withstand a 600-volt breakdown test.

2.5.4 Joint Compound

Joint compounds shall be resistant to water and be suitable for use with fuel containing 40 percent aromatics.

2.5.5 Flexible Pipe Connector

Connector shall be the flexible, close pitch, metal hose type that is constructed with exterior annular corrugations and provided with a single layer of braided wire sheath covering. Connectors shall be constructed entirely of stainless steel and be rated for the system working pressure and temperature. Provide threaded end connections for connectors smaller than 2-1/2 inches. Provide flanged end connections for connectors 2-1/2 inches and larger.

2.5.6 Strainer

Strainer shall be the in-line, cleanable, simplex basket type configured in either an "S" or "T" pattern. Strainer body shall be fabricated of
Type 304 or 316 stainless steel. Provide strainer with a drain and with drain piping that is inclusive of a flanged ball valve. Strainer shall be equipped with a removable cover, flanged end connections, an air eliminator, ports for connection of differential pressure sensor tube, and arrows clearly cast on the strainer sides that indicate the direction of flow. Strainers shall have a removable, 60 mesh, Type 316 stainless steel wire sediment screen. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

2.5.7 Thermometers

Thermometer shall be the analog, dial-type bimetallic actuated type that conforms to ASME B40.200. Thermometer shall have a 5 inches diameter dial, a hermetically sealed stainless steel case, a stainless steel stem, a safety glass face, a fixed threaded connection, and a scale range as indicated. Thermometer accuracy shall be within one percent of the scale range.

2.5.8 Pressure Gauge

Gauge shall be the single style type that conform to ASME B40.100. Gauge shall have a 4-1/2 inches dial, a stainless steel case and tube, a stainless steel ball valve, pressure snubbers, and a scale range as indicated.

2.5.9 Pipe Hangers and Supports

Hangers and supports shall be the adjustable type conforming to MSS SP-58 and MSS SP-69, except as modified herein. Provide Type 316 stainless steel rods, hangers, supports, nuts, bolts, washers, and screws. Provide miscellaneous metal that conforms to ASTM A36, standard mill finished structural steel shapes, hot-dipped galvanized.

2.5.9.1 Pipe Protection Shields

Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Provide shields at each slide type pipe hanger and support.

2.5.9.2 Low Friction Supports

Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.002 inch under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Provide anti-friction material with a minimum of 0.09 inch thick. Provide hot-dipped galvanized steel supports. Provide supports that are factory designed and manufactured.

2.5.10 Escutcheon

Escutcheon shall be the chrome plated, stamped steel, hinged, split ring type. Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the corresponding floor, wall, or ceiling opening. Provided each escutcheon with necessary set screws.
2.5.11 Flexible Ball Joint

Joint shall be the carbon steel type with chromium plated steel balls capable of 360 degree rotation plus 15 degree angular flex movement. Provide joints with flanged end connections and pressure molded composition gaskets designed for continuous operation at operating conditions.

2.5.12 Bellows Expansion Joint

Joint shall be the guided, bellows expansion type with internal sleeves, external protective covers, and flanged end connections. Bellows shall be corrugated, Type 304 stainless steel with reinforced rings. Joints shall be provided with limit stops to limit total movement in both directions. Joints shall be capable of withstanding 10,000 cycles over a period of 20 years.

2.5.13 Sight Flow Indicator

Indicator shall be constructed of stainless steel and be provided with flanged end connections. Indicator shall include an internal rotating propeller to provide visual flow indication. Indicator housing shall include a tempered glass observation port for viewing the rotating propeller. Indicator shall have Buna-N seals.

2.5.14 Fuel Oil Meter

Provide volumetric positive displacement type meter that conforms to ASTM F1172, except as modified herein. Meter shall indicate the fuel oil flow rate in gpm. Meter shall be provided with overspeed protection and a water escape hole. If meter is not mounted in-line with the piping, then an appropriate pedestal for mounting shall be provided. Install meter in accordance with manufacturer's recommendations. Meter shall be capable of providing a 4-20 mA analog output signal for the fuel flow rate.

2.5.15 Vent Cap

Provide atmospheric, updraft type cap. Cap shall be constructed of aluminum or carbon steel. Cap shall have an internal brass or bronze insect screen, minimum 40-mesh. Cap shall prevent rain, snow, or ice from entering the vent piping.

2.6 GENERAL VALVES

Provide valves that meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein. Valves shall have flanged end connections and conform to ASME B16.34, Class 150 except as modified herein. Provide stainless steel stem and trim for each valve. Valves shall have a weatherproof housing. Seats, body seals, and stem seals shall be Viton or Buna-N.

a. Carbon Steel Piping. Provide valves with bodies, bonnets, and covers constructed of cast steel conforming to ASTM A216.

b. Stainless Steel Piping. Provide valves with bodies, bonnets, and covers constructed of stainless steel conforming to ASTM A743, Type 304 or 316; or cast steel conforming to ASTM A216, Grade WCB internally plated with nickel or internally electrodeless nickel
2.6.1 Swing Type Check Valve

Valve shall be the full-opening, tilting disc, non-slam, swing type that conforms to API Spec 6D. Discs and seating rings shall be renewable without removing from the line. The disc shall be guided and controlled to contact the entire seating surface.

2.6.2 Ball Valve

Valve shall be the non-lubricated, double seated, ball type that conforms to API Spec 6D. Valve shall operate from fully open to fully closed with 90 degree rotation of the ball. Valve shall be capable of 2-way shut-off. Valve ball shall be constructed of stainless steel. For valves 2 inches and larger, provide full bore type. Valves smaller than 2 inches shall have one piece bodies and shall have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. Balls shall be provided with trunnion type support bearings for valves 14 inches and larger. Provide valves with worm gear operators, except valves 6 inches and smaller may be lever operated with a minimum 10 adjustable positions between fully opened and fully closed.

2.6.3 Globe Valve

Valve shall conform to ASME B16.34, Class 150.

2.6.4 Plug Valve (PTFE Sleeved Tapered Type)

Valve shall be the non-lubricated, PTFE sleeved tapered plug type that conforms to API Spec 6D. Valve shall have 360 degree port defining lips to retain the sleeve against deforming into the flow passages. Valve shall provide abrasion protection and shall prevent fuel entry behind the sleeve. Plug shall operate with a 90 degree turn for closure. For valves installed in loop or distribution piping, provide valve body with a body cavity drain connection.

2.6.5 Plug Valve (Double Block and Bleed Type) 2.6.5.1 Valve Operation

Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Maximum number of turns from full close to full open shall be eight. Rotation of the plug toward open shall lift the plug without wiping the seals and retract the sealing slips so that clearance is maintained between sealing slips and valve body. Rotation of the handwheel toward closed shall lower the plug after sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, slips shall form a secondary fire-safe metal to metal seat on both sides of the resilient seal.

2.6.5.2 Pressure Relief

Provide plug valve with an automatic thermal relief valve(s) to relieve pressure buildup in the internal body cavity when the plug valve is closed. Relief valve shall open at a 25 psi differential pressure, and discharge to the throat of and to the upstream side of the plug valve.
2.6.5.3  **Bleed Valve**

Provide a manually operated bleed valve for each plug valve in order to verify that the plug valve is not leaking when in the closed position. Provide discharge piping so that released liquid from each bleed valve can be contained.

2.6.6  **Pressure Relief Valve**

Valve shall be the fully enclosed, spring loaded, angle pattern, ball seated type with lift lever. Valve shall have corrosion-resistant valve seats. Valve stem shall be fully guided between the fully opened and fully closed positions. Valve shall be factory set to open at the indicated pressure (plus or minus ten percent deviation). Valve setpoint shall be field adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint.

2.6.7  **Pressure\Vacuum Relief Valve**

Valve shall be the pressure\vacuum vent relief type that conforms to NFPA 30. Valve pressure and vacuum relief settings shall be set at the factory. Pressure and vacuum relief shall be provided by a single valve. Valve body shall be constructed of either cast steel or aluminum. Valve trim shall be stainless steel. Inner valve pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored. Valve intake shall be covered with a 40 mesh stainless steel wire screen.

2.6.8  **Foot Valve**

Valve shall be the self-activating, double-poppet, shutoff type that prevents fuel flow from reversing. Valve shall conform to NFPA 30. Valve body shall be constructed of either cast steel or aluminum. Valve shall be provided with a minimum 20 mesh stainless steel screen on the intake. Valve seats shall be the replaceable type. Valve shall be capable of passing through a 3 inches pipe or tank flange.

2.6.9  **Tank Overfill Prevention Valve**

Valve shall be the two-stage, float-activated, shutoff type that is an integral part of the drop tube used for gravity filling. The first stage shall restrict the flow of fuel into the tank to approximately 5 gpm when the liquid level rises above 90 percent of tank capacity. The second stage shall completely stop the flow of fuel into the tank when the liquid level rises above 95 percent of tank capacity. Valve shall be constructed of the same material as the fill tube.

2.7  **PUMPS**

Pumps shall be driven by an explosion-proof motor for Class I, Division 1, Group D hazardous locations as defined in NFPA 70. Pump assemblies shall be statically and dynamically balanced for all flow rates from no flow to 120 percent of design flow. Pump motors shall be non-overloading throughout their entire pump curve.

2.7.1  **Submersible Pump**

Pump shall be the multi-stage, vertical type. Pump and motor combination
shall operate totally submerged in the product of the storage tank. Pump shall extend within 6 inches of the storage tank bottom. Pump fuel inlets shall be horizontal. Pump mounting shall completely support both the weight and vibration of the pump. Pump shall include a steel lifting lug capable of supporting the weight of the entire pump and motor assembly. Pump shall include a vertical solid shaft motor, base mounting flange, horizontal pump discharge, low net positive suction head (NPSH) first stage impellers, and dynamic and thrust balancing of impellers. Pump shall be accessible for servicing without disturbing connecting piping. Pump baseplate, casing, and bearing housing shall be of cast iron construction. Pump shall be provided with a stainless steel one piece pump shaft. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Provide pump with flanged end piping connections.

2.7.2 Rotary Pumps

Pump shall conform to CID A-A-50561, Type I, Style A. Mount pump and driver on extended base plate. Motor starters on pumps shall be lockable.

2.7.3 Pump Control Panel

Panel shall include on and off indication lights for each pump. Panel shall contain an adjustable control logic for pump operation in accordance with the indicated operation. Panel shall also have a manual override switch for each pump to allow for the activation or deactivation of each pump.

2.8 ACCESSORIES

2.8.1 Concrete Anchor Bolts

Concrete anchors shall conform to ASTM A307, Grade C, hot-dipped galvanized.

2.8.2 Bolts and Studs

Carbon steel bolts and studs shall conform to ASTM A307, Grade B, hot-dipped galvanized. Stainless steel bolts and studs shall conform to ASTM A193, Class 2, Grade 8.

2.8.3 Nuts

Carbon steel nuts shall conform to ASTM A563, Grade A, hex style, hot-dipped galvanized. Stainless steel nuts shall conform to ASTM A194, Grade 8.

2.8.4 Washers

Provide flat circular washers under each bolt head and each nut. Washer materials shall be the same as the connecting bolt and nut. Carbon steel washers shall conform to ASTM F844, hot-dipped galvanized. Stainless steel washers shall conform to ASTM A194, Grade 8.

2.8.5 Polytetrafluoroethylene (PTFE) Tape

Tape shall conform to ASTM D3308.
2.8.6 Pipe Sleeves

Provided sleeves constructed of hot-dipped galvanized steel Schedule 20.

2.8.7 Buried Utility Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in minimum 3 inches width rolls, color coded for the utility involved, with warning identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning identification shall be at least 1 inch high and shall state as a minimum "FUEL PIPING BELOW". Provide permanent code and letter coloring that is unaffected by moisture and other substances contained in trench backfill material.

2.9 FINISHES

Ship, store, and handle coating materials as well as apply and cure coatings in accordance with SSPC PA 1.

2.9.1 Exterior Coating, Direct Buried Piping

2.9.1.1 Factory Coating

Provide direct buried pipe and piping components with a factory-applied, adhesive undercoat and continuously extruded plastic resin coating in accordance with NACE SP0185 or AWWA C215; minimum thickness of plastic resin shall be 36 mils for pipe sizes 6 inches and larger.

2.9.1.2 Girth Welds

Coat girth welds using one of the following processes.

- a. Heat shrink sleeves in accordance with AWWA C216
- b. Wax tape coatings in accordance with AWWA C217
- c. Cold applied tape coatings in accordance with AWWA C209

2.9.1.3 Damaged Coatings

Repair damaged coating areas using one of the following processes.

- a. Wax tape coatings in accordance with AWWA C217
- b. Cold applied tape coatings in with AWWA C209

2.9.1.4 Rock Shield

Provide a minimum 3/8 inch thick perforated rock shield around buried piping. Rock shield shall consist of a polyethylene outer surface bonded to a closed cell foam substrate with uniform perforations intended for use with cathodic protection systems. Rock shield shall overlap on itself no less than 6 inches. Secure rock shield tightly to the pipe using either strapping tape or plastic ties. Air filled cell type rock shields are prohibited.

2.9.2 Exterior Coating, Aboveground Piping

Coat the exterior of aboveground steel piping, flanges, fittings, nuts,
bolts, washers, valves, and piping components, as defined in this specification, in accordance with Section 09 90 00 PAINTS AND COATINGS.

2.9.3 New Equipment and Components

2.9.3.1 Factory Coating

Unless otherwise specified, provide equipment and components fabricated from ferrous metal with the manufacturer's standard factory finish. For equipment and component surfaces subject to temperatures above 120 degrees F, the factory coating shall be appropriately designed for the temperature service.

2.9.3.2 Field Painting

Painting required for surfaces not otherwise specified shall be field painted as specified in Section 09 90 00 PAINTS AND COATINGS. Do not paint stainless steel and aluminum surfaces. Do not coat equipment or components provided with a complete factory coating. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease.

PART 3 EXECUTION

3.1 INSTALLATION

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.3 and NFPA 30, except as modified herein. Safety rules as specified in NFPA 30 shall be strictly observed. Never direct bury threaded connections, socket welded connections, unions, flanges, valves, air vents, or drains. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

3.1.1 Pumps

Properly level, align, and secure pumps in place in accordance with manufacturer's instructions. Support, anchor, and guide so that no strains are imposed on a pump by weight or thermal movement of piping.

3.1.2 Piping

3.1.2.1 General

Thoroughly clean pipe of all scale and foreign matter before the piping is assembled. Cut pipe accurately to measurements established at the jobsite, and worked into place without springing or forcing. Cut pipe square and have burrs removed by reaming. Install pipe to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval.

a. Use reducing fittings for changes in pipe sizes. Install equipment and piping into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Provide electric isolation fittings between dissimilar metals. Install piping straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain as indicated. Make changes in direction.
with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted.

b. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. When work is not in progress, securely close open ends of pipe and fittings with an expandable pipe plug so that water, earth, or other substances cannot enter the pipe or fittings. For belowground piping, the full length of each pipe shall rest solidly on the underlying pipe bed.

3.1.2.2 Exterior Containment Piping System

Install exterior containment piping in accordance with manufacturer's instructions. Do not assemble joints in an exterior containment piping system until the successful completion of the tests defined in paragraph "FIELD QUALITY CONTROLS".

3.1.2.3 Welded Connections

Unless otherwise indicated on the drawings, pipe joints shall be welded. Construct branch connections with welding tees or forged welding branch outlets. Do not weld stainless steel pipe to carbon steel pipe.

3.1.2.4 Threaded End Connections

Provide threaded end connections only on piping 2 inches in nominal size or smaller and only where indicated on the drawings. Provide threaded connections with PTFE tape or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is tighten.

3.1.2.5 Brazed Connections

Provide brazing in accordance with AWS BRH, except as modified herein. During brazing, fill pipe and fittings with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Remove surplus brazing material at all joints. Support piping prior to brazing and do not be spring or force piping.

3.1.2.6 Existing Piping Systems

No interruptions or isolation of an existing fuel handling service or system shall be performed unless the actions are approved by the Government Representative. Perform initial cutting of existing fuel pipe with a multiwheel pipe cutter, using a nonflammable lubricant. After cut is made, seal interior of piping with a gas barrier plug in accordance with API BULL 2209. Purge interior of piping with carbon dioxide or nitrogen prior to performing any welding process.

3.1.3 Bolted Connections

For each bolted connection of stainless steel components (e.g., pipes, piping components, valves, and equipment) use stainless steel bolts or
studs, nuts, and washers. For each bolted connection of carbon steel components, use carbon steel bolts or studs, nuts, and washers. Extend bolts, or studs, no less than two full threads beyond their corresponding nut when tightened to the required torque. Prior to installing nuts, apply a compatible anti-seize compound to the male threads.

3.1.4 Flanges and Unions

Except where threaded end connections and/or unions are indicated, provide flanged joints in each line immediately preceding the connection to a piece of equipment or material requiring maintenance such as pumps, general valves, control valves, strainers, and other similar items and as indicated. Assemble flanged joints square and tight with matched flanges, gaskets, and bolts. For flanges, provide washers under each bolt head and nut. Torque wrenches shall be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern shall be as recommended by the gasket manufacturer. Use anti-seize compound on threads for stainless steel bolts.

3.1.5 Flange Protectors

Provide flange protectors where indicated on the drawings.

3.1.6 Valves

Install isolation plug or ball valves on each side of each piece of equipment, at the midpoint of looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Install valves with stems vertically up unless otherwise indicated. Provide individual supports and anchors for each valve.

3.1.7 Air Vents

Provide 2 inches air vents at all high points and where indicated to ensure adequate venting of the piping system.

3.1.8 Sight Flow Indicator

Mount indicator rolled one bolt hole to prevent freeze damage from rainwater accumulation on viewing window. Install a sight flow indicator downstream of each relief valve.

3.1.9 Drains

Provide 1-1/2 inches drains at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.10 Flexible Pipe Connectors

Attach connectors to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.
3.1.11 Bellows Expansion Joints

Cold set joints to compensate for the temperature at the time of installation. Provide initial alignment guides on the connecting piping no more than 4 pipe diameters from the expansion joint. Provide additional alignment guides on the connecting piping no more than 14 pipe diameters from the first guide.

3.1.12 Thermometers

Provide thermometers with separable sockets. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing fluid and minimize obstruction to flow.

3.1.13 Pipe Sleeves

Provide a pipe sleeve around any pipe that penetrates a wall, floor, or crosses under a roadway. Do not install sleeves in structural members except where indicated or approved. Install pipe sleeves in masonry structures at the time of the masonry construction. Sleeves shall be of such size as to provide a minimum of 1/2 inch all-around clearance between bare pipe and the sleeve. Align sleeve and piping such that the pipe is accurately centered within the sleeve by a nonconductive centering element. Securely anchor the sleeve to prevent dislocation. Closure of the space between the pipe and the pipe sleeve shall be by means of a mechanically adjustable segmented elastomeric seal. The seal shall be installed so as to be flush. For wall or floor penetrations, extend each sleeve through its respective wall or floor and cut flush with each surface. For roadway crossings, pipe sleeves shall be continuous for the entire crossing as well as extend a minimum of 6 inches beyond both sides of the crossing. Seal around sleeves that penetrate through valve or fuel related pits with a Buna-N casing seal. Seal around sleeves that penetrate through fire-rated walls and floors as specified in Section 07 84 00 FIRESTOPPING.

3.1.14 Escutcheons

Except for utility or equipment rooms, provide finished surfaces where exposed piping pass through floors, walls, or ceilings with escutcheons. Secure escutcheon to pipe or pipe covering.

3.1.15 Pumps

Properly level, align, and secure pumps in place in accordance with manufacturer's instructions. Support, anchor, and guide so that no strains are imposed on a pump by weight or thermal movement of piping.

3.1.16 Access Panels

Provide access panels for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK AND MISCELLANEOUS PROVISIONS.

3.1.17 Buried Utility Tape

Bury tape with the printed side up at a depth of 12 inches below the top
surface of earth or the top surface of the subgrade under pavements.

3.1.18 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. Frame under glass or laminated plastic the framed instructions and post where directed by the Government Representative. Post the framed instructions before the system performance tests.

3.2 PIPE HANGERS AND SUPPORTS

Install hangers with a maximum spacing as defined in Table 1 below, except where indicated otherwise. In addition to meeting the requirements of Table 1, provide additional hangers and supports where concentrated piping loads exist (e.g., valves).

<table>
<thead>
<tr>
<th>Nominal Pipe Size (Inches)</th>
<th>One and Under</th>
<th>1.5</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Hanger Spacing (ft)</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td>19</td>
<td>22</td>
<td>23</td>
</tr>
</tbody>
</table>

3.2.1 Structural Attachments

Provide attachments to building structure concrete and masonry by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Apply inserts and anchors with a safety factor not less than 5. Do not attach supports to metal decking. Construct masonry anchors for overhead applications of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.3 FIELD QUALITY CONTROLS

3.3.1 Tests

Furnish labor, materials, equipment, electricity, repairs, and retesting necessary for any of the tests required herein. Perform piping test in accordance with the applicable requirements of ASME B31.3 except as modified herein. To facilitate the tests, various sections of the piping system may be isolated and tested separately. Where piping sections terminate at flanged valve points, close the line by means of blind flanges in lieu of relying on the valve. Provide tapped flanges to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Use tapped flanges for gauge connections. Taps in the permanent line will not be permitted. Gauges will be subject to testing and approval. Provide provisions to prevent displacement of the piping during testing. Keep personnel clear of the piping during pneumatic testing. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing. Isolate equipment such as pumps, tanks and meters from the piping system during the testing. Do not exceed the
pressure rating of any component in the piping system during the testing. Following satisfactory completion of each test, relieve the test pressure and seal the pipe immediately. Piping to be installed underground shall not receive field applied exterior coatings at the joints or be covered by backfill until the piping has passed the final pneumatic tests described herein.

3.3.1.1 Exterior Coating Holiday Test

Following installation, test the exterior coating of direct buried piping for holidays using high-voltage spark testing in accordance with NACE SP0188. Repair holidays and retest to confirm holiday-free coating. Text shall include all existing underground piping exposed for this project.

3.3.1.2 Preliminary Pneumatic Test

Apply a 25 psig pneumatic test to product piping. Maintain the pressure while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble formations). If leaks are discovered, repair the leaks accordingly and retest.

3.3.1.3 Final Pneumatic Test

Following the preliminary pneumatic test, apply a 50 psig pneumatic test to all product piping and hold for a period not less than 2 hours. During the test period, there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. Disconnect the pressure source during the final test period. If leaks are discovered, repair the leaks accordingly and retest.

3.3.1.4 Hydrostatic Test

Hydrostatically test product piping with the fuel to be handled to the lesser of 1-1/2 times operating pressure or 275 psig in accordance with API RP 1110. Maintain the pressure within the piping for 4 hours with no leakage or reduction in gauge pressure. If leaks are discovered, repair the leaks accordingly and retest.

3.3.1.5 Exterior Containment Piping Tests

Apply a minimum pneumatic pressure of 5 psig to the exterior containment piping. Maintain the pressure for at least 1 hour while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble formations). Repair leaks discovered in accordance with manufacturer's instructions and retest. Perform testing in compliance with the manufacturer's published installation instructions.

3.4 DEMONSTRATIONS

Conduct a training session for designated Government personnel in the operation and maintenance procedures related to the equipment/systems specified herein. Include pertinent safety operational procedures in the session as well as physical demonstrations of the routine maintenance operations. Furnish instructors who are familiar with the installation/equipment/systems, both operational and practical theories,
and associated routine maintenance procedures. The training session shall start after the system is functionally completed, but prior to final system acceptance. Submit a letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

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1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)


AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318M (2011; Errata 2011; Errata 2012) Building Code Requirements for Structural Concrete & Commentary


ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)


ASTM B8 (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors,
Hard, Medium-Hard, or Soft


ASTM C478 (2012a) Standard Specification for Precast Reinforced Concrete Manhole Sections


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


IEEE 404 (2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V

IEEE 48 (2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV


IEEE C2 (2012; Errata 2012; INT 1-4 2012) National
Electrical Safety Code

IEEE C37.20.3 (2001; R 2006) Standard for Metal-Enclosed Interrupter Switchgear

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)


INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


NEMA RN 1 (2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758 (2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Medium voltage cable; G
Medium voltage cable joints; G
Medium voltage cable terminations; G
Live end caps; G
Precast concrete structures; G

Sealing Material

Pulling-In Irons

Manhole frames and covers; G
Handhole frames and covers; G
Composite/fiberglass handholes; G
Cable supports (racks, arms and insulators); G

SD-06 Test Reports

Arc-proofing test for cable fireproofing materials; G
Medium voltage cable qualification and production tests; G
Field Acceptance Checks and Tests; G
Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure

Six (6) copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.
The dates of cable pulls, time of day, and ambient temperature.

The length of cable pull and calculated cable pulling tensions.

The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Cable splicer/terminator; G

Cable Installer Qualifications

1.5 QUALITY ASSURANCE

1.5.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.5.2 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Government Representative, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Government Representative reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.5.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.
1.5.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Government Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi.

2.1.2 Intermediate Metal Conduit

UL 1242.
2.1.2.1 Intermediate Metal Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi.

2.1.3 Plastic Conduit for Direct Burial

UL 651, Schedule 40 or Schedule 80 as indicated.

2.1.4 Plastic Duct for Concrete Encasement

NEMA TC 6 & 8 and ASTM F512, UL 651, EPC-40-PVC or as indicated.

2.1.5 Innerduct

Provide corrugated or solid wall polyethylene (PE) or PVC innerducts with pullwire. Size as indicated.

2.1.6 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.

2.1.7 Fittings

2.1.7.1 Metal Fittings

UL 514B.

2.1.7.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.7.3 PVC Duct Fittings

NEMA TC 9.

2.1.7.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements, or in accordance with NEMA WC 70. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted. Service entrance
conductors shall conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. All conductors shall be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW conforming to UL 44. Copper conductors shall be annealed copper complying with ASTM B3 and ASTM B8. Aluminum conductors shall be Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801, and shall be of an aluminum alloy listed or labeled by UL as "component aluminum-wire stock (conductor material). Type EC/1350 is not acceptable. Intermixing of copper and aluminum conductors is not permitted.

2.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.2.4 Direct Buried

Single-conductor and multi-conductor cables shall be of a type identified for direct burial.

2.2.5 In Duct

Cables shall be single-conductor cable.

2.2.6 Cable Marking

Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves, or colored electrical tape. Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 208/120 volt, three-phase

   (1) Phase A - black
(2) Phase B - red  
(3) Phase C - blue  

b. 480/277 volt, three-phase  
(1) Phase A - brown  
(2) Phase B - orange  
(3) Phase C - yellow  
c. 120/240 volt, single phase: Black and red  
d. On three-phase, four-wire delta system, high leg shall be orange, as required by NFPA 70.

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS  
Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.  

a. For use with copper conductors: UL 486A-486B.  
b. For use with aluminum conductors: UL 486A-486B. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

2.4 LOW VOLTAGE SPLICES  
Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply ANSI C119.1.

2.4.1 Heat Shrinkable Splice  
Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice  
Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 MEDIUM VOLTAGE CABLE  
Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 24 months prior to date of
delivery to the site shall not be accepted. Provide single conductor type cables unless otherwise indicated.

2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072 metallic armored cables, consisting of three-conductor, multi-conductor cables, with insulation and shielding, as specified, using an aluminum interlocked tape armor and thermoplastic jacket. Provide cables manufactured for use in duct or direct burial applications as indicated. Cable shall be rated 5 kV, 15 kV, 25 kV, 35 kV as indicated with 133 percent insulation level.

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B conductors. Provide soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659 and AEIC CS8, ICEA S-94-649.

2.5.4 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape or wire shield for each phase.

2.5.5 Neutrals

Neutral conductors of shall be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable. Concentric neutrals conductors shall be copper, having a combined ampacity 1/3 of the phase conductor ampacity rating. For high impedance grounded neutral systems, the neutral conductors from the neutral point of the transformer or generator to the connection point at the impedance shall utilize copper conductors, employing the same insulation level and construction as the phase conductors.

2.5.6 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial. Provide type UD cables with an overall jacket.

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations shall be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and
installations. Terminations shall be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator shall be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Termination shall be designed for installation in low or highly contaminated indoor or outdoor locations.

2.6.3 Separable Insulated Connector Type

IEEE 386. Provide connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points.

a. 200 Ampere loadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 10,000 rms symmetrical amperes.

2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints shall be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 Heat-Shrinkable Joint

Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.
2.7.2 Cold-Shrink Rubber-Type Joint

Joint shall be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket shall be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice shall be packaged three splices per kit, including complete installation instructions.

2.8 LIVE END CAPS

Provide live end caps using a "kit" including a heat-shrinkable tube and a high dielectric strength, polymeric plug overlapping the conductor. End cap shall conform to applicable portions of IEEE 48.

2.9 TAPE

2.9.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.9.2 Buried Warning and Identification Tape

Provide detectable tape per industry standards.

2.9.3 Fireproofing Tape

Provide tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.10 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.11.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B1 for sizes No. 8 and smaller. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Aluminum is not acceptable.

2.12 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE. In addition, provide concrete for encasement of
underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.13 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C857 and ASTM C478. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2.13.1 Cast-In-Place Concrete Structures

Concrete shall conform to Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE. Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers. Concrete block is not allowed in areas subject to aircraft loading.

2.13.2 Precast Concrete Structures, Risers and Tops

In lieu of cast-in-place, Contractors, at their option, may provide precast concrete underground structures subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.13.2.1 General

Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.13.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:
a. Angle of Internal Friction (\( \phi \)) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (\( K_a \)) = 0.33

d. Ground Water Level = 3 feet below ground elevation

e. Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.

f. Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.

g. Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

h. Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.13.2.3 Construction

Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.13.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict
accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.13.3 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.13.4 Handhole Frames and Covers

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of stainless steel with bronze hinge pin, 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

2.13.5 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C32, Grade MS.

2.13.6 Composite/Fiberglass Handholes and Covers

Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass.

2.14 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.14.1 Cable Racks

The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.

2.14.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of 8 inches and a maximum of 12 inches.

2.14.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.15 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags shall be polyethylene. Do not provide handwritten letters. The first position on the power cable tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek
"phi" symbol. The last position shall denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.15.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.16 CABLE TERMINATING CABINETS

Cable terminating cabinets shall be hook-stick operable, deadfront construction conforming to the requirements of IEEE C37.20.3, Category A. Cabinets shall be provided with 200 A. loadbreak junctions and elbow-type separable loadbreak connectors, cable parking stands, and grounding lugs. Provide cable terminating equipment in conformance with IEEE 386.

Ratings at 60 Hz shall be:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (kV)</td>
<td>13.8</td>
</tr>
<tr>
<td>Rated maximum voltage (kV)</td>
<td>15</td>
</tr>
<tr>
<td>Rated continuous current (A)</td>
<td>200</td>
</tr>
<tr>
<td>Three-second short-time current-carrying capacity (kA)</td>
<td>15</td>
</tr>
<tr>
<td>BIL (kV)</td>
<td>95</td>
</tr>
</tbody>
</table>

2.17 PROTECTIVE DEVICES AND COORDINATION

Provide protective devices and coordination as specified in Section 26 05 19 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

2.18 SOURCE QUALITY CONTROL

2.18.1 Arc-Proothing Test for Cable Fireproofing Tape

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus...
or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

2.18.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Prior to installation, each cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then prepare a checklist of significant requirements which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.
f. Cable percentage conduit fill.
g. Cable sidewall bearing pressure.
h. Cable minimum bend radius and minimum diameter of pulling wheels used.
i. Cable jam ratio.
j. Maximum allowable pulling tension on each different type and size of conductor.
k. Maximum allowable pulling tension on pulling device.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors shall be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit shall be PVC, Type EPC-40 from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete.

3.5.1 Cast-In-Place Concrete Structures

Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

3.5.2 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation shall additionally conform to the manufacturer's instructions.

3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors.
Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks shall be as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.5 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be
cleaned of mortar, rust, grease, dirt and other deleterious materials, and
given a coat of bituminous paint.

3.6 DIRECT BURIAL CABLE SYSTEM

Cables shall be buried directly in the earth below the frostline to the
requirements of NFPA 70 and IEEE C2, whichever is more stringent.

3.6.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to
provide the minimum necessary cable cover. When rock is encountered,
remove to a depth of at least 3 inches below the cable and fill the space
with sand or clean earth free from particles larger than 1/4 inch.
Bottoms of trenches shall be smooth and free of stones and sharp objects.
Where materials in bottoms of trenches are other than sand, a 75 mm 3 inch
layer of sand shall be laid first and compacted to approximate densit 6
inches wide, and shall be in straight lines between cable markers. Cable
plows shall not be used. Bends in trenches shall have a radius consistent
with the cable manufacturer's published minimum cable bending radius for
the cable installed.

3.6.2 Cable Installation

Cables shall be unreeled along the sides of or in trenches and carefully
placed on sand or earth bottoms. Pulling cables into direct-burial
trenches from a fixed reel position will not be permitted, except as
required to pull cables through conduits under paving or railroad tracks.

Where two or more cables are laid parallel in the same trench, space
cables laterally at not less than 3 inches apart, except that
communication cable shall be separated from power cable by a minimum
distance of 12 inches.

Where direct-burial cables cross under roads or other paving exceeding 5
feet in width, such cables shall be installed in concrete-encased ducts.
Where direct-burial cables cross under railroad tracks, such cables shall
be installed in reinforced concrete-encased ducts. Ducts shall extend at
least 1 foot beyond each edge of any paving and at least 5 feet beyond
each side of any railroad tracks. Cables may be pulled into duct from a
fixed reel where suitable rollers are provided in the trench. Where
direct burial cable transitions to duct-enclosed cable, direct-burial
cables shall be centered in duct entrances, and a waterproof nonhardening
mastic compound shall be used to facilitate such centering. If paving or
railroad tracks are in place where cables are to be installed, coated
rigid steel conduits driven under the paving or railroad tracks may be
used in lieu of concrete-encased ducts. Damage to conduit coatings shall
be prevented by providing ferrous pipe jackets or by predrilling. Where
cuts are made in any paving, the paving and subbase shall be restored to
their original condition. Where cable is placed in duct (e.g. under paved
areas, roads, or railroads), slope ducts to drain.

3.6.3 Splicing

Provide cables in one piece without splices between connections except
where the distance exceeds the lengths in which cables are manufactured.
3.6.4 Bends

Bends in cables shall have an inner radius not less than those specified in NFPA 70 for the type of cable, or manufacturer's recommendation.

3.6.5 Horizontal Slack

Leave approximately 3 feet of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.

3.6.6 Identification Slabs Markers

Provide a slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways. Identification slabs shall be of concrete, approximately 20 inches square by 6 inches thick and shall be set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches above ground. Concrete shall have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "telephone cable," "splice," or other applicable designation on the top surface of the slab before concrete hardens. Inscribe circuit identification symbols on slabs as indicated. Letters or figures shall be approximately 2 inches high and grooves shall be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top shall include an arrow indicating the side nearest the cable. Provide color, type and depth of warning tape.

3.7 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.7.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in structures.

3.7.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water.
or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.7.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.7.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers.

3.7.5 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.7.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.7.7 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weep hole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.7.8 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of
the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape.

3.7.8.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

3.7.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape.

3.7.9.1 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.7.9.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7.9.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and extend into the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.
3.7.9.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks. Abandon in place those no longer used ducts and cables which do not interfere with the work.

3.7.9.5 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.7.9.6 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.8 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape or wire shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.8.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.9 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.
3.9.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.10 CONDUCTORS INSTALLED IN PARALLEL

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.11 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes, handholes, or aboveground termination cabinets.

3.12 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.13 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.14 CABLE END CAPS

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.15 LIVE END CAPS

Provide live end caps for single conductor medium voltage cables where indicated.
3.16  FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.16.1  Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.17  GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

<table>
<thead>
<tr>
<th>Description</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad-mounted transformers without protective fences</td>
<td>5 ohms</td>
</tr>
<tr>
<td>Ground in manholes</td>
<td>5 ohms</td>
</tr>
<tr>
<td>Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment</td>
<td>5 ohms</td>
</tr>
</tbody>
</table>

3.17.1  Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 12 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, the Government Representative shall be notified immediately.

3.17.2  Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.
3.17.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.17.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.17.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.17.6 Fence Grounding

Fences shall be grounded as indicated. Drive ground rods until the top is 12 inches below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 12 inches of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 1/8 by one inch flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.18 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 23 16.16 12 STRUCTURAL EXCAVATION AND BACKFILL.

3.18.1 Reconditioning of Surfaces

3.18.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.
3.18.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.19 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE for Army projects.

3.19.1 Concrete Slabs for Equipment

Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.19.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.20 FIELD QUALITY CONTROL

3.20.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.20.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's
minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) Visually inspect jacket and insulation condition.

(7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests shall be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE 400.2. VLF test frequency shall be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages shall be as follows:

<table>
<thead>
<tr>
<th>CABLE RATING</th>
<th>AC TEST VOLTAGE for ACCEPTANCE TESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 kV</td>
<td>10kV rms (peak)</td>
</tr>
<tr>
<td>8 kV</td>
<td>13kV rms (peak)</td>
</tr>
<tr>
<td>15 kV</td>
<td>20kV rms (peak)</td>
</tr>
<tr>
<td>25 kV</td>
<td>31kV rms (peak)</td>
</tr>
<tr>
<td>35 kV</td>
<td>44kV rms (peak)</td>
</tr>
</tbody>
</table>

3.20.1.2 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable megohmmeter tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
3.20.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Government Representative shall be given 5 working days advance notice of the dates and times of checking and testing.

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DIVISION 34 - TRANSPORTATION

SECTION 34 11 00.01

CONSTRUCTION ON OR ADJACENT TO RAILROAD TRACKS

04/08

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1.3   REFERENCES
1.4   RELATED WORK SPECIFIED ELSEWHERE
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PART 2   PRODUCTS

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PART 3   EXECUTION

3.1   INSTALLATION AND REMOVAL
3.2   BALLAST AND SUB-BALLAST

-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The worked covered by this section consists of furnishing all plant, labor, equipment, and materials required to perform work in connection with sustaining railroad operations during construction on or adjacent to railroad tracks. No change in the order of work will be made, unless written approval is obtained from the Railroad Company and the Government Representative. Except for physical removal and replacement of existing railroad and the cross-ties, the Contractor shall be responsible for all work required to facilitate the continuous passage of trains throughout construction, including coordinating with the KCS and CN Railroad Companies and other interested parties, performing work as specified herein and as shown on the drawings and providing construction equipment necessary to assist the Railroad Company in removing and replacing rails. The Contractor will not be required to furnish tracks, cross-ties, creosoted timber filler blocks, and other special railroad materials or equipment which are common to normal track work, as shown on the drawings. The Contractor shall be required to furnish all material, labor and equipment required for construction of the railroad false work, including steel H-piles, sheeting and bracing, structural steel falsework and connecting hardware, as shown on the drawings. The Railroad Company will remove and replace that portion of the tracks necessary to install the falsework. The Contractor shall coordinate with the KCS and CN Railroad Companies in order to avoid unnecessary inconvenience and to ensure that construction methods and timing produce no interference with any train traffic. The Contractor will be allowed two twelve hour periods with no train traffic during the construction and must make arrangements and coordinate the timing of this period with the Railroad. See Section General Provisions section, Work on or Adjacent To Railroad Tracks (KCS and CN), for other requirements by the railroad companies.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1557 (2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
1.4 RELATED WORK SPECIFIED ELSEWHERE
   a. Section 31 62 16.00 12 "STEEL H-PILES."
   b. Section 31 41 16.00 12 "STEEL SHEET PILING."
   c. Section 31 05 19.04 12 "SEPARATOR GEOTEXTILE."

1.5 PERMITS

The Contractor shall obtain all required permits from the KCS and CN Railroad Companies for removal and crossing of tracks and for all work required on or adjacent to the railroad and within their rights-of-way. The permits will be issued by the KCS and CN Railroad Companies and will be valid for the duration of the project.

PART 2 PRODUCTS

2.1 BALLAST

Main track Ballast shall be AREMA Number 4 crushed limestone in accordance with the AREMA manual. Ballast shall be provided by the Contractor.

2.2 SUB-BALLAST

Sub-Ballast should be a dense graded aggregate material conforming with Part 2, Section 2.11 of the AREMA Manual and meeting the following gradation limits:

<table>
<thead>
<tr>
<th>Sieve Size (Square Opening)</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>50-84</td>
</tr>
<tr>
<td>#10</td>
<td>26-50</td>
</tr>
<tr>
<td>#40</td>
<td>12-30</td>
</tr>
<tr>
<td>#200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

Sub-ballast shall be manufactured by mixing, screening and testing a combination of materials to produce a mixture conforming to the requirements specified herein. Sub-ballast shall be provided by the Contractor.

PART 3 EXECUTION

3.1 INSTALLATION AND REMOVAL

   a. The falsework structures shall be constructed in conformance with the details on the drawings. The Contractor shall furnish and drive the steel H-piles, furnish and construct the sheet piling bracing, furnish and install the structural steel as shown on the drawings. The KCS and CN Railroad Companies will furnish and install the cross-ties, creosoted timber, filler blocks, tracks, and any other special railroad materials or equipment required to complete the track work as shown on the drawings. The Contractor shall remove and
replace the falsework structure as directed by the KCS and CN Railroad Companies. The KCS and CN Railroad Companies will connect and disconnect the tracks as required. The Contractor shall submit a schedule for the work required at the railroad tracks and coordinate all work efforts with the KCS and CN Railroad Companies.

b. The Contractor shall remove the falsework structure(s) as required for construction and shall replace the falsework structure(s) to restore the tracks to service as directed by the KCS and CN Railroad Companies. The KCS and CN Railroad Companies will disconnect and reconnect the tracks with the assistance of the Contractor.

3.2 BALLAST AND SUB-BALLAST

a. The Contractor shall make his/her own arrangements with NOGCR to unload and distribute the ballast materials for surfacing using an approved method.

b. After the falsework structures have been removed and the fill brought to the grade shown on the drawings and compacted, the geotextile fabric shall be installed to the outer limits of the sub-ballast. The geotextile fabric shall be stored, handled and installed in accordance with Section 31 05 19.04 12 "SEPARATOR GEOTEXTILE".

c. Place the first layer of sub-ballast material directly on the geotextile exercising care not to disturb the geotextile. Place, spread and compact the sub-ballast in two or more layers of equal thickness. Place and spread sub-ballast material so as to avoid segregation of the material and pockets of large or fine materials. Remix any segregated material until a uniform mixture is obtained. Maintain the material at a moisture content sufficient to permit proper compaction and preclude raveling or loss of material throughout the placing and compacting operation. Immediately after spreading each layer, the sub-ballast material shall be compacted, for the full depth of each layer to a minimum of 95 percent of the relative density as determined by ASTM D 1557. The moisture content of the sub-ballast material shall not be more than 2 percentage points above or below the optimum moisture content of the material as determined by AASHTO Designation T-99, Method D.

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE
The work provided for herein consists of furnishing all plant, labor and materials and equipment and designing, manufacturing, factory testing, delivering, storing, installing and field testing five (5) - 120" X 120" (10' x 10') sluice gates and three (3) hydraulic actuators complete with all necessary accessories and appurtenances, all as shown on the contract drawings and specified herein. Electrical work is specified in the applicable sections of Division 26 - ELECTRICAL.

1.2   MEASUREMENT AND PAYMENT
Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   EQUIPMENT TO BE INSTALLED

1.3.1   Sluice Gates
The following equipment, together with all necessary accessories and appurtenances, shall be installed, as required for five (5) - 120" x 120" (10' x 10') complete gates: gate frames and guides, gate slides and wall thimbles. The following paragraphs may at times describe or refer to only one item, assembly or arrangement, but these requirements shall apply to all such items, assemblies or arrangements furnished under these specifications.

Sluice gates shall be as manufactured by Jash Engineering LTD, JASH Model No. SG-S/120" x 120"-Cl or Rodney Hunt or approved equal.

Three (3) sluice gates located at river side of headworks intake structure will be operated by hydraulic actuators. Two (2) sluice gates located at end of intake structure shall be manually operated.

1.3.2   Central Hydraulic Power Unit (CHPU)
This specification is for use with one (1) Central Hydraulic Power Unit (CHPU) and three (3) Linear Hydraulic Piston Actuators on 120" x 120" (10' x 10') sluice gate valves.

The CHPU provides hydraulic energy (required flow and pressure) modulating the position of the three actuators for controlling water flow rate through the gates. Details of the CHPU and the actuator requirements are described herein. Below are summary of the requirements:

a) CHPU and the Valve Actuators shall be supplied by the same System manufacturer to assure compatibility. The system manufacturer shall have at least 15 years of experience in design and manufacturing of hydraulic actuators system with a CHPU operating multiple actuators. The System Manufacturer shall demonstrate successful installation of
CHPU-actuator system where kidney loop filtration and reservoir breather balder were used to control moisture and contamination.

b) Gate valve manufacturer shall provide required thrust values for operating the valve. Actuator shall be sized with a 25 percent safety factor for operating thrust.

c) Duty cycle of actuators: The actuators will set at apposition for many hours or days and then change to a new position as per command for new flow. Typical duty cycle may be one position change in a day for any or all actuators.

d) Actuator Modulating precision: Actuator position control output shall be linear to 4 to 20 mA command from control room. Actuator shall modulate within 1/2 inch as the accuracy for the gate position (+/- 1/2 inch corresponds to +/- 0.06 mA command approximately). Precision, Deadband used for controls, and actuator speed shall be adjusted for the optimized system performance without oscillations and instability.

e) Actuator speed shall be adjustable and shall be initially adjusted to 12 inches per minute speed. One full valve stroke takes approximately 10 minutes.

f) Simultaneous operation: When command signals (4 to 20 mA signal) are changed to all the actuators at the same time, it is not absolutely required that that all actuators operate same time or synchronize to reach new position. Operation can be sequential or simultaneous or a combination.

g) Fail action: On loss of main AC electric power, the actuator shall stay at last position (stayput). On loss of command signal, with electric power available, actuators shall fail close. Optionally, a 12VDC backup battery system at the CHPU be used to close or open the valve on loss of main AC supply which will drive a DC motor pump. The backup system will be automatically charged from main power. The CHPU also shall allowed to run the pump from a truck battery through a jumper cable.

h) Location of the system: The Central Hydraulic Power Unit (CHPU) is located inside the building at the headworks structure. The actuators are located outdoors.

i) Actuator Controls: Actuators are normally operated from 4-20 mA command from a control room. The command signals correspond to the position of the actuators. CHPU and the actuators shall be controlled by Siemens PLC (S7-300 series or S7-1500 series type) for control and annunciation is OK.

j) Hydraulic Oil used shall be Mineral oil Standard premium antiwear mineral hydraulic oil. Chevron AW32 Hydraulic oil shall be used for hydraulic oil and one fill of oil will be supplied by the contractor.

k) Oil should be filtered properly with the system kidney loop filtration before operation of the actuators. New oil used shall be filtered through high efficiency filter (with minimum Beta ratio of 1000 for 10 micron particles). The system fluid cleanliness level shall be equal to ISO (International Standards Organization) Contamination Code 18/16/12 or better.
1) System Suppliers: System manufacturer shall provide 2-day supervisory start-up assistance in testing and operational training of the CHPU system.

m) System Manufacturer shall provide the CHPU and the 3 actuators. Interconnecting wiring and plumbing among the CHPU and the actuators and all associated field installation will be by the contractor.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
AGMA 6010 (1997f) Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives

ASTM INTERNATIONAL (ASTM)

U.S. DEPARTMENT OF DEFENSE (DOD)
MIL-C-16173D (Am. 2) Corrosion Preventive Compound, Solvent Cutback, Cold-Application

1.5 DESIGN

The sluice gates shall be products of a manufacturer who has been regularly engaged during the past five years in the production of similar-sized gates for the design heads specified herein. Based on the heads specified in the paragraph "Description," working stresses shall not exceed the lower value of either one-third of the yield strength or one-fifth of the ultimate strength of the material. The gates accessories and appurtenances shall be designed for installation as shown on the contract drawings.

1.6 ERECTING ENGINEER

The Contractor shall furnish the services of a competent erecting engineer to supervise and direct the installation and testing of the gates furnished under this section. The erecting engineer shall be a full-time employee of, and designated as such by, the gate manufacturer, shall have
had at least five years of experience with the type of gate furnished under these specifications and shall be subject to the approval of the Government Representative. The services of the engineer shall be furnished at no extra cost to the Government. The installation and testing of the gates under the direction and supervision of the erecting engineer shall in no way relieve the Contractor of sole responsibility for the gates meeting all requirements of the specifications and fulfilling all the Contractor's guarantees.

1.7 WORKMANSHIP

All workmanship, whether in the factory or the field, shall be performed in a skillful and workmanlike manner by qualified mechanics under competent supervision and direction and in accordance with the best modern practice for the various trades involved and for the manufacture of high-grade machinery. All parts shall have accurately machined mounting and bearing surfaces so that they can be assembled without fitting, chipping or remachining. All parts shall conform to the design dimensions and shall be free of all defects in either workmanship or material that will impair their service. All attaching bolt holes shall be accurately drilled to the layout indicated on the shop drawings and dimensional outline drawings.

1.8 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Complete shop drawings of the gate shall be submitted to the Government Representative for approval. Drawings of any items made specially or specifically for this project shall be true shop drawings, but catalog cuts will be sufficient for standard manufactured articles, and outline drawings of such equipment may be used in the assembly drawings. However, for those items for which true shop drawings are not required, sufficient descriptive data and/or other information, in addition to the catalog cuts, shall be submitted to demonstrate compliance with the specifications. The embedded items and structural openings and clearances, which are dependent upon the gate design, shall be included with the shop drawings.

Dimensional Outline Drawings; G

The Contractor shall furnish the Government Representative for his review and approval dimensional outline drawings, catalog data and other information and calculations for each size unit which will include at least the following:

(1) Name of hydraulic cylinder manufacturer.

(2) Model number and weight.
(3) Dimensional drawing.

(4) Descriptive bulletin, including a breakaway drawing illustrating all operating components, a parts list and materials of construction.

(5) Strength and durability HP ratings per AGMA 6010.

(6) The maximum and operating stem opening and closing load.

(7) Equipment sizing calculations, including all related factors and supporting literature.

(8) Calculations showing the required stem size and bracing required under condition (9) above for L/R < 200.

(9) Control hydraulic diagram.

(10) The Contractor shall furnish drawings and documents covering the Central Hydraulic Power Unit (CHPU), actuators and system components. Drawings shall include an outline dimension/general arrangement layout of the HPU skid components plus a bill of materials identifying major components and appurtenances. Hydraulic and electrical circuit diagrams for the entire system (i.e., actuators, control panels, CHPU and interconnections) within the scope of the hydraulic system supplier shall be included in the drawing package. All the wiring at the PLC and backup system shall be included in the package.

(11) Operation and Maintenance Manual shall be provided in soft format shall include final "as-built" information along with parts lists and instruction sheets. Operation Manual should clearly identify, within the scope of supply of the system manufacturer, installation procedure for the system, start up, testing, operation and maintenance procedures.

1.9 QUALITY CONTROL

1.9.1 General

The Contractor shall establish and maintain quality control for sluice gate operations to assure compliance with contract requirements and maintain records of his quality control for all construction operations, including but not limited to the following:

(1) Machine work and electrical work.

(2) Shop painting.

(3) Galvanizing.

(4) Use of specified materials and equipment.

(5) Shop assembly and tests.

(6) Preparation for shipment and storage.

(7) Inspection at the worksite for damage to and defects in all material and equipment.
(8) Storage at the worksite.

(9) Field painting.

(10) Installation and tests.

(11) Operation and maintenance after installation.

1.9.2 Reporting

The original and four copies of these records of inspection and tests, as well as the corrective action taken, shall be furnished to the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.10 PREPARATION FOR SHIPMENT

Prior to shipment from the manufacturer's plant, the manufacturer shall prepare the gate for shipment as described herein. All large, bulky and/or heavy elements shall be mounted on skids or pallets of ample size and strength to facilitate loading and unloading. All small parts shall be boxed in sturdy wood or heavy corrugated paperboard boxes. A packing list, indicating the contents of each such box and enclosed in a moisture-proof envelope, shall be securely fastened to the outside of the box. The skid and/or pallet mounting and the boxing shall be done in a manner which will prevent damage to the gate during loading, shipment, unloading, storage and any associated and/or subsequent handling. Weatherproof covers shall be provided during shipment to protect all items which the Government Representative designates as requiring such protection. Any special slings, strong backs, skidding attachments or other devices used in loading the equipment at the manufacturers' and/or fabricators' plants shall be furnished for unloading and handling at the destination and shall become the property of the Government.

1.11 PREPARATION FOR STORAGE

At the conclusion of all shop tests, the gate shall be protectively processed for not less than 24-month storage either outdoors or indoors as the case may be, at the destination. Bulky parts of the gate not particularly susceptible to damage from exposure, such as the frame, slide, etc., may be stored outdoors. Other parts, such as fasteners shall be stored indoors. The Contractor shall furnish for approval, a complete description of the processing method or methods he intends to use, including complete instructions for maintaining the protection during the storage period. Surfaces of items or of portions of items which are to be embedded in or rest on concrete, shall be cleaned of all dirt, rust, and other foreign coatings, not including closely-adhering mill scale, and then coated with a rust preventative meeting the applicable requirements of MIL-C-16173D for "Grade 2." This coating shall be removed before the item is installed on or embedded in concrete.

1.12 STORAGE

Upon delivery at the worksite, bulky parts of the gates, such as the frames, slides and wall thimbles, which have been coated with a complete paint system in the manufacturer's plant, may be stored outdoors provided these parts are stored on wood blocking not less than 8 inches above a base of washed gravel or crushed stone not less than 2 inches thick.
other elements of the gates shall be stored in a weathertight building. A framework covered with a plastic film, or any other such expedient or makeshift arrangement, will not be acceptable. The Contractor shall inspect the storage site at least once per day. The Contractor shall submit a detailed description of the proposed storage facilities, and a plan for storage maintenance and inspection, before any storage actually begins.

1.13 WARRANTY

The Contractor warrants that the gate will be free from defects in design, materials and workmanship for a period of one year from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier. Upon receipt of notice from the Government of failure of any part of the gate during the warranty period, due to the above-stated causes, new replacement parts shall be furnished and installed promptly by the Contractor at no additional cost to the Government.

1.14 OPERATION AND MAINTENANCE MANUAL AND PARTS LISTS


The Contractor shall furnish 5 copies of manuals containing complete detailed information in connection with the operation, lubrication, adjustment, routine and/or special maintenance, disassembly, repair and reassembly of all mechanical, electrical, and control components of the gate furnished under this section.

1.14.2 Parts Lists

The Contractor shall furnish 5 copies of the manufacturer's spare parts lists and/or bulletins for each item of mechanical equipment furnished under this section. These lists and/or bulletins shall clearly show all details and parts, and all parts shall be adequately described and/or have proper identification marks.

1.14.3 General

The operation manual, the maintenance manual, and the parts lists shall be bound separately, shall be approximately 8-1/2 inches by 11 inches, printed on good quality paper and bound between flexible, durable covers. Drawings incorporated in the manual and/or parts lists may be reduced to page size provided they are clear and easily legible, or may be folded into the manual to page size. Photographs and/or catalog cuts of components may be included for identification.

1.15 MAINTENANCE

After completion of the installation, the Contractor shall continue to maintain and protect the gate and shall keep it ready for operation at any time until acceptance thereof. The Contractor shall provide electrical power in accordance with applicable Sections in Division 26 - ELECTRICAL for all operation and testing of the gates until final acceptance by the Government.
PART 2 PRODUCTS

2.1 MATERIALS

All materials shall be free from defects and imperfections, of recent manufacture and unused, and of the classifications and grades specified herein unless otherwise approved by the Government Representative. Material not specifically described shall, as far as practicable, conform to the latest specifications of the American Society for Testing and Materials (ASTM). All materials, supplies and articles not manufactured by the Contractor shall be the products of recognized reputable manufacturers. Samples of materials shall be submitted for approval when so directed. Equipment, materials and articles installed or used without such approval shall be at the risk of subsequent rejection.

2.1.1 Iron Castings

Material for iron castings shall meet the applicable requirements of ASTM A126 for "Class B with 2 percent nickel".

2.1.2 Bronze

Bronze castings for such items as wedges, thrust nuts, lift nuts and couplings shall meet the applicable requirements of ASTM B584, C86500 for "Copper Alloy No. 865." Bronze extrusions for seat facings in the frame and slide shall meet the applicable requirements of ASTM B21 for "Copper Alloy No. 482" or "Copper Alloy No. 464".

2.2 SLUICE GATES

2.2.1 Description

All gate components shall be designed to safely withstand the heads listed in the Sluice Gate Schedule.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Gate Size</th>
<th>Design Seating Head</th>
<th>Design Unseating Head</th>
<th>Operating Head</th>
<th>Type Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>120&quot; x 120&quot;</td>
<td>40 ft</td>
<td>20 ft</td>
<td>20 ft</td>
<td>Water Control</td>
</tr>
</tbody>
</table>

Maximum outlet design discharge - 667 CFS

The Sluice gates shall be cast iron (ASTM A126, CL B with 2 percent nickel), fully bronze mounted; shall have side wedges for seating head conditions; side, top and bottom wedges; and shall be the rising stem, flush-bottom type.

The gate shall be one-piece construction, rectangular with integrally cast vertical and horizontal ribs. A reinforcing rib along each side shall be provided to ensure rigidity between the side wedges. The gate shall have machined dovetailed grooves on the seating face into which bronze seat facings shall be driven and machined to a 63 micro-inch finish. A tongue on each side, extending the full length of the disc, shall be machined on all sides with a 1/16 inch clearance maintained between the disc tongue.
and gate guide groove. Wedge pads for side, top, and bottom wedges, when required, shall be cast integrally on the disc and machined to receive adjustable bronze wedges. A heavily reinforced nut pocket shall be cast integrally on the vertical centerline and above the horizontal center, and be of such shape to receive the square-backed thrust nut.

The 3 nos additional Open channel Slide gates shall also be of cast iron (ASTM A126, CL B with 2 percent nickel). The gate frame should be suitable for embedding within the groove of the side walls and provided with guide extending up to the top to enable easy insertion of slide. The slide gates shall have adjustable side wedges to assist in pressurizing the resilient sealing arrangement provided on sides. The bottom sealing arrangement shall be flush-bottom type. The gate guides shall have bronze seating face fitted up to the top so as to provide corrosion-free smooth sealing face for the resilient seals.

The gate shall be one-piece construction, rectangular with integrally cast vertical and horizontal ribs. A reinforcing rib along each side shall be provided to insure rigidity between the side wedges. A tongue on each side, extending the full length of the disc, shall be machined on all sides with a 1/16 inch clearance maintained between the disc tongue and gate guide groove. Wedge pads for side shall be cast integrally on the disc and machined to receive adjustable bronze wedges. The gate/disc shall be designed to close against the water pressure on its own self-weight. These Gates shall be JASH Model # SG-s/120X120-C1 or engineer approved equal.

2.2.2 Frame

The frame shall be the flange back type and of one piece, cast-iron construction (ASTM A126, CL B with 2 percent nickel) with the mounting flange and rectangular opening as indicated on the plans. All contact surfaces of the frame shall be machine-finished to a 63 micro-inch finish. The frame shall be machined on its front face to accommodate the seat facings. A machined cast-iron stop bar shall be bolted and keyed to the frame to form a flush invert. The back face of the frame shall be drilled and machined to bolt directly to the machined face of the thimble. All bolt holes shall be drilled using templates to match the thimble. The frame shall have integrally cast pads with machined surfaces and keyways to receive the side, wedging devices.

2.2.3 Guides

The guides shall be of one-piece, cast-iron construction (ASTM A126, CL B with 2 percent nickel), conservatively designed to withstand the total thrust due to the water pressure and the wedging action. The guides shall be machine-finished on all contact surfaces, and a groove shall be machined the full length of the guide to provide sufficient clearance between the slide tongue and the guide groove to permit free movement and ensure proper engagement of the wedging devices. The guides shall have machined areas on their front faces for at least one-half the vertical gate opening and shall be sufficiently long to retain and support at least one-half of the slide when the gate is in the full-open position. The guides shall be attached to the frame with steel and bronze fasteners and shall be doweled to prevent relative motion between the guides and frame. Integrally cast pads with machined surfaces shall be provided for attachment of the wedging devices.
2.2.4 Slide

The slide shall be either square or rectangular and of one-piece, cast-iron construction (ASTM A126, CL B with 2 percent nickel) with integrally-cast vertical and horizontal ribs and a reinforced section around the perimeter to provide for the seat facings. The slide shall have machined areas on its seating face to accommodate the seat facings. A tongue shall be provided on each side of the slide, shall extend its full length and shall be machined on all sides to provide sufficient clearance between the tongue and the guide groove to permit free movement. Integrally cast pads shall be provided and machine-finished to receive the wedges. A stem nut pocket shall be cast integrally on the vertical centerline and above the horizontal center and shall be shaped to receive the stem nut.

2.2.5 Wedging Devices

The gate shall be provided with sufficient side wedging devices to limit leakage to 0.1 gallon per minute per foot of perimeter at the specified maximum seating. The wedging devices shall be of solid cast bronze, machine-finished on all contact surfaces and keyed to the cast-iron pads to maintain adjustment. The wedging devices shall be attached with either bronze or steel studs and bronze nuts, and the adjustable element shall be provided with a bronze adjusting screw with either a bronze lock nut or another approved locking device.

2.2.6 Seat Facings

Seat facings shall be of extruded bronze. The facings shall be attached to the machine-finished areas on the frame, guides and slide by bolting, brazing, dovetail-type grooving or another method approved by the Government Representative. The width of the facing shall be not less than 3/4-inch. After attachment, the facing shall be machined to a plane surface and to at least a 63 micro-inch finish. The seal shall be a specially molded shape designed to produce a wide sealing area on the machined stop bar bolted to the frame. The differential sealing pressure of the seal on the stop bar shall be capable of being varied by adjustment of the side wedging devices.

2.2.7 Wall Thimble

The wall thimbles shall be of one-piece, cast-iron construction (ASTM A126, CL B with 2 percent nickel) of "E" and "F" cross section as shown on the contract drawings, and provided with an integrally cast ring or water stop. The front flange face shall be machine finished to a plane surface and provided with tapped holes, using a template to match the drilling of the frame. The vertical centerline shall be clearly shown by permanent marks at the top and bottom of the machined surface and the word "TOP" shall be permanently marked thereon. The thimble shall be provided with holes in the invert to permit satisfactory concrete placement. A permanent gasket of uniform thickness shall be provided between the front face of the thimble and the back face of the frame.

2.2.8 Stem, Couplings and Stem Guides

The stem shall be of sufficient diameter to withstand, without buckling or permanent distortion, the stresses induced by closing the gate under locked the head conditions. The stem and nut threads shall have sufficient contact area so that the contact pressure will not exceed 5,000
psi when the maximum stem thrust is exerted. The stem thread surfaces in contact with the lift nut shall have not rougher than a 63 micro-inch finish if machine cut and not rougher than a 32 micro-inch finish if roll-formed. The exterior corners of the threads, either during or after machining, shall be given a slight radius of approximately 0.015-inch in order to prevent them from acting as cutting edges as the stem passes through the lift nut. The stem shall be of corrosion-resisting steel. The stem shall be fitted with a tapped hole in the top end for handling. The tapped hole shall be of sufficient diameter and depth for the insertion of an eyebolt of sufficient strength to pick up the entire stem from a horizontal position. The stem shall be provided at its lower end with a bronze thrust nut which will fit into the pocket provided therefore on the slide and which will positively prevent rotation of the stem. Stem guides shall be of cast-iron, bronze bushed and mounted on cast iron brackets. They shall be drilled and slotted so as to be adjustable in two directions and shall be spaced at close enough intervals to support the stem adequately with an L/R ratio of not more than 200. The bronze bushing shall be machine-bored 1/16-inch to 1/8-inch larger than the stem diameter. The stem guide, including the bronze bushing, shall be the two-piece collar type which can be installed and removed with the stem in place. Stem guides shall be attached with corrosion resistant steel anchor bolts.

2.2.9 Fasteners

All fasteners shall be of either silicon bronze or corrosion-resisting steel. The quantity and size of fasteners shall be as recommended by the gate manufacturer.

2.2.10 Not Used

2.2.11 Flush Bottom Closure

The flush bottom closure shall have a compressible resilient seal attached to the bottom of the gate with a stainless steel bar and fasteners. The seal will be of a specially extruded shape, and designed to accurately fit to the bottom rib of the gate. The seal will be shaped to produce a wide sealing area on a machined cast iron (ASTM A126, CL B with 2 percent nickel) stop bar that is bolted to the gate frame to form a flush invert.

The differential sealing pressure of the resilient seal on the stop bar will be variable by adjustment of the side wedges on the gate.

2.2.12 Painting

The gate manufacturer shall be responsible for shop prime and finish painting of the gates and appurtenances supplied under this contract. All coatings shall conform with VOC Emission Regulations in effect at the manufacturing location and at project site to allow touch-up or recoating to be performed with the same products. The type of paint shall be as specified in the following schedule.

Colors are to be manufacturer's standards, provided they are selected for ease of field touch up and color match and are fade resistant.

Colors shall be selected to provide contrast between the product and prime coat, and between the prime coat and finish coat, to insure uniform covering and coating thickness. All coatings shall be applied in accordance with the paint manufacturer's recommendations for thinning,
technique, and safety precautions. All coatings shall be produced by Ameron Protective Coating Divisions, Brea, CA, or equal.

2.3 HYDRAULIC VALVE ACTUATORS

2.3.1 Equipment and Materials

a) Each hydraulic valve actuator shall be sized at or below a nominal 1500 psi maximum operating pressure using hydraulic piston actuator. A 1.25 safety factor for required valve thrust shall be applied for sizing the actuator. The actuator cylinder shall be rated for 3000 psi pressure.

b) The cylinder shall be designed to National Fluid Power Association (NFPA) standards and shall be rated for 3000 psi pressure. Cylinder shall be provided with wiper seals appropriate to the humid environment. The cylinder design shall allow operation in a humid environment. The bore size of the actuator cylinder shall not be less than 12 inch bore.

c) The actuator piston rod shall be chrome plated stainless steel and shall conform to National Fluid Power Association standards. The cylinder shall be provided with a minimum of eight (8) inch stop tube at the rod end to reduce jack knife effect and to increase bearing life. Cylinder rod shall be sized to prevent bucking. Cylinder rod shall be at least 5.5 inches in diameter. The cylinder head, cap, and body, shall be made of steel. Cylinder tie rods and tie rod nuts shall be stainless steel. The cylinder exterior shall be provided with epoxy coating for corrosion protection.

d) All seals shall made of a material that is compatible with Chevron AW32 premium antiwear hydraulic oil or an appropriate vegetable based hydraulic oil. The cylinder rod wiper seal shall include means to alleviate ingress of water into the cylinder.

e) Each actuator shall be sized to provide sufficient opening and closing thrust required from the valve manufacturer. A minimum 25 percent safety factor shall be applied to the required valve thrust before sizing.

f) Actuator shall be mounted in the field by the contractor with coupling supplied by the valve manufacturer. Valve actuator coupling shall be stainless steel and shall be adjustable type. The coupling should be adjusted such that the jamming of the valve to the seat is not possible by the cylinder in closed position. In fully open position, the cylinder cap end shall handle the complete load from full hydraulic pressure without transferring load to the valve bonnet.

g) Actuator shall include a position transducer with 4 to 20 mA output for use in modulating control. The position transducer shall be built into the cylinder cap end and shall be magnetostrictive type such as made by MTS Systems or Balluff or equal. The transducer shall be protected from weather.

h) Two limit switches shall be provided for the actuator, one for open position and another for closed position. The limit switches shall be stainless steel proximity type.

i) Each actuator hydraulic circuit shall be provided with speed control valves, one for controlling opening speed and the other for controlling the closing speed. The flow control valves shall be assembled to a manifold at the CHPU. Actuator speed shall be adjustable. Normal speed
required is 12 inches of travel per minute.

j) During modulation of the actuators, the PLC located inside a Hydraulic Control Panel at CHPU shall manage closed loop control of all the 3 actuators. Provision should be provided for slower travel near the cap end of the cylinder during fast opening to minimize impact loads and hydraulic transients.

k) Each actuator shall be provided with a counterbalance valve so that when the hydraulic pressure is lost, the weight of the valve gate will not cause an open valve to close by gravity. Size the counterbalance valve to suit the gate weight. The counterbalance valve also should be designed to prevent cylinder cavitation when the valve is closed. Only Direct acting, near-zero-leakage poppet type, counterbalance valve will be used for the application. Counterbalance shall not use cross port piloting.

l) The Contractor shall use 316 stainless steel tubing for interconnecting the actuators and hydraulic power unit (CHPU).

m) Each actuator shall be provided with two stainless steel isolation ball valves so that if one actuator is removed for maintenance, the hydraulic system can operate other actuators. Another ball valve across the actuator should be provided to bypass the two cylinder ports for flushing the hydraulic system.

n) Actuators are double acting type. On loss of electric power, the actuators shall stay in last position. Any drift rate from the last position shall be minimized and should be limited by choice of components.

o) Actuator ports will have thermal relief valves to prevent excessive pressure in cylinder created from hot ambient conditions.

p) Dual Pilot operated check valves should hold the cylinder in the last position.

2.3.2 Actuator Operation

a) Each actuator shall receive a 4-20mA command as command setpoint from control room, supplied by others. The PLC Control panel shall compare this position command setpoint with the position feedback from the transducer at the actuator. If the command position and the feedback position are different, then the hydraulic system shall allow fluid to flow to appropriate cylinder port through solenoid directional control valves so that the commanded position is reached. A deadband shall be provided at the PLC to alleviate hunting of the actuator, so that when the difference between the commanded position and the actual feedback position is within this deadband, the solenoids shall de-energize. Solenoid voltages shall be 24 VDC. Power supply for the solenoid shall be by the hydraulic system supplier. Solenoids are mounted in a manifold at the CHPU.

b) The feedback control system shall be appropriately designed to avoid oscillations and instability from the interaction of the gate inertia and the cylinder hydraulic fluid stiffness and resulting (possible low) natural frequency.

c) Actuator position shall be available for indication to remote control room.
2.3.3 Piping and Fittings

a) Stainless steel tubing type 316, ASTM A269, shall be used for all tubing. All tubing shall be seamless.

b) Pipe fittings shall be stainless steel. NPT type fittings should be avoided as far as practical. Use SAE O-ring type fittings to minimize leakage issues.

c) Pipe Size: Return line piping shall be selected such that the fluid velocity is less than or equal to seven feet per second.

Supply line piping shall be selected such that the fluid velocity is less than or equal to fifteen feet per second.

2.3.4 Testing

Each gate valve shall be operated through three full cycles to assure the proper operation of the assembly. The Owner's Representative shall have the right to witness the test. Testing of the actuators shall include automatic and manual controls.

2.4 CENTRAL HYDRAULIC POWER UNIT (CHPU)

2.4.1 Scope

This section covers the requirements for the supply of one Central Hydraulic Power Unit (CHPU) for operating all the three valve actuators. The work required shall include the following system design:

a) Furnish one (1) CHPU with two (2) main AC motor driven pumps, one (1) AC motor driven filtration pump, one (1) 12VDC motor driven pump, one (1) hand pump, accumulators, motor starters, PLC Control Panel, and all accessories mounted on a skid. All items within the skid shall be plumbed and wired as complete assembly by the actuator manufacturer ready for installation by contractor.

b) The CHPU includes two (2) accumulators and two reservoir breather bag bladder.

c) Contractor shall connect all external and interfacing hydraulic piping and tubing and electrical power lines to operate the hydraulic actuators on the gate valves.

2.4.2 Equipment and Materials

a) Hydraulic controls system shall be designed for 3000 psi maximum hydraulic pressure. Normal flow rate from each of the two main AC operated pumps shall be 6 gpm minimum. HP for the main AC motors shall be minimum 15 HP. Normal operation of the actuators shall be at or below 1500 psi. However, the pressure shall be adjustable to suit the field requirements, up to a maximum of 3000 psi.

b) Two Accumulators, each 5 gallon size, shall be provided for reducing pump pulsations, transients and to minimize shock loads on the hydraulic cylinders. Accumulators shall be bladder type, nickel coated body and rated for 3000 psi. Each accumulator shall have a stainless steel isolation valve. Each accumulator shall also will have a bleed off needle valve to release oil pressure after closing the accumulator isolation.
valve. Mount the accumulators at the CHPU skid. Contractor shall precharge the accumulators in the field with dry nitrogen at about 750 psig.

c) A smart pressure transmitter, with 4-20 mA output, is installed at the pressure line for remote monitoring and annunciation purpose. Additionally, a temperature transmitter with 4-20 mA output and a level transmitter with 4-20 mA output shall be installed at the hydraulic reservoir. Control PLC at the Hydraulic panel will continuously monitor the transducer output and provide the information for use at the Flow Control PLC. The Hydraulic PLC will also use the transmitter data for safety shut down of the CHPU.

d) All components shall be mounted in a position which will facilitate adjustment and maintenance of the unit.

e) Piping and Fittings

f) All tubing shall be 316 stainless steel ASTM A269. Tubing shall be seamless. Unless otherwise specified, tube fittings shall be Swagelok.

g) Pipe Size: Suction lines shall be sized according to the pump manufacturer's data sheets. Cross sectional area of the piping shall be sufficient to prevent cavitation and starvation. Pumps shall have positive suction head, Pumps shall not have suction strainer to minimize damage from clogged elements.

Suction piping shall be selected such that the fluid velocity is within the range of two to four feet per second.

Return line piping shall be selected such that the fluid velocity is less than or equal to seven feet per second.

Pressure line piping shall be selected such that the fluid velocity is less than or equal to fifteen feet per second.

All piping, pipe fittings, oil passages, cored holes or drilled holes shall be free of burrs and foreign matter that might cause damage to any hydraulic component or contamination of the hydraulic fluid.

2.4.3 Reservoirs

Reservoir shall contain sufficient fluid for displacement of the cylinder rods for all the actuators plus the accumulator volume. Reservoir size shall be minimum size of 120 gallon and shall be constructed of 1/4 inch stainless steel plates. Internal baffles shall be provided for allowing air bubbles to settle and to avoid immediate mixing of suction and return oil.

The reservoir shall be designed and constructed to minimize entry of foreign matter including water. Use two breather bag bladder for reservoir breathing to alleviate entry of dirt and moisture. The breather bag bladders shall be sized for a volume of 1.5 times normal volume change in the reservoir. The breather bag bladder shall be mounted at the side of the CHPU skid. The bladder size shall be 2 each 20 gallon nominal size.

The reservoir shall be designed for adequate heat dissipation. The fluid level shall be visible in the sight gauge during the normal operating cycle. The level gauge should have isolation valves for ease of
replacing without having to drain the oil. The level gauge shall be stainless steel type.

An oil level transmitter, magnetostrictive type, shall be provided at the reservoir. It shall be possible to remove the transmitter and float from the top of the reservoir. Level transmitter output shall be 4 to 20 mA type. A PLC at the CHPU shall monitor the level for warning and diagnostics.

A temperature transmitter shall be provided to measure the fluid temperature. Output from the transmitter shall be 4-20 mA and connected to the PLC at the CHPU.

A non-vent type filler shall be supplied and mounted on a riser. It shall have a built-in strainer for straining the fluid while filling. This filler shall be completely capped during normal operation. Additionally, a breather with 10 micron filter shall be provided at the reservoir with an isolation valve. This isolation valve and breather are functional only during filling or servicing the HPU and the valve will be closed during normal operation.

A stainless steel vacuum breaker and relief valve should be provided for the reservoir to prevent excessive pressure or vacuum inside the reservoir, the setting of the pressure relief and vacuum break relief valves shall not exceed 0.5 psig or 0.25 psig vacuum. The vacuum break and relief valves shall be tested for absence of leakage in normal operation within its relief setpoint.

Ample and accessible provisions shall be made for complete cleaning of the reservoir.

A stainless steel tank drain valve shall be provided.

2.4.4 Pumps and Motors

Two, 15 HP, AC motor driven pumps shall be provided for the system. It shall be possible to operate Pump #1 as main with Pump #2 as standby or with Pump #2 as main and Pump #1 as standby. Motor power shall use 480 VAC, 3 phase, 60 Hz, Motors shall be TEFC Squirrel Cage induction Type running at 1800 rpm. Each motor will drive a pressure compensated variable displacement piston pump. The pressure compensator shall be set at a maximum of 1500 psi at shipment. Flow rate from pump should be adjustable at set at 6 gpm initially. The piston pump shall have a maximum volume stop to adjust the maximum flow rate.

A 12 VDC motor operated pump shall be included in the power unit for emergency operation from a DC power source. The DC power source controls shall be installed onto the CHPU by the manufacturer. Main AC power shall charge a set of battery which shall be located at convenient location near the CHPU by the contractor. The battery should be sized for operation of all the actuators one time from full open to full close at a speed not less than one (1) inch per minute. Additionally, the DC motor shall have provision for operation from a truck battery. Contractor will run positive and negative cables to an enclosure at the curb from a starter solenoid at the CHPU. The starter solenoid shall be wired to the 12DC motor at the CHPU by the hydraulic system supplier. An On/OFF switch will be provided at the HPU to START/STOP the 12DC pump. In operation, the truck batteries OR the battery backup power is connected to motor. With truck engine running, the START/STOP switch at the CHPU is used to operate the system.
A selector switch is used to choose battery backup or truck battery. Selector switch in Backup mode, the DC motor can be run from the backup power source. The DC motor is used for emergency operation when main power is lost. Manual operation of valves at the CHPU will operate the gate each of the gate valve at a time as required. As a minimum, the 12 VDC pump shall provide ½ gpm flow at 2000 psi. Motor shall be able to run at least 30 minutes at a time to close the valve before cooling down for another 30 minutes. Provide the motor control with thermal overload protection.

Provide a "kidney loop" filtration system for keeping the oil clean. The kidney loop sucks oil from the hydraulic reservoir by a nominal 2 gpm gear pump, filters it and send it back to the hydraulic tank. The gear pump shall be driven by a 1 HP, 460 VAC/ 3 ph/ 60 Hz TEFC induction motor. It shall be possible to use the kidney loop pump to fill the tank or drain most of the oil from the hydraulic tank. Provide necessary valving for achieving the filling/drain function. The filter pump shall run automatically at predefined schedules.

A hand pump shall be provided for manual operation of valve actuators. The handpump shall be mounted at the CHPU.

The pumps and the motor shall be close coupled. The couplings shall have adequate capacity to transmit the power required.

ALL PUMPS SHALL HAVE POSITIVE SUCTION HEAD TO ALLEVIATE ISSUES FROM CAVITATION.

All the pumps operate in parallel. Provide stainless steel Isolation Ball valves to permit removal of one pump while the others are still in operation. Each pump shall have its own relief valve to protect against over pressurizing or as safeguard against pump compensator failure. Additionally, a system relief valve shall be provided at the common pressure header. All relief valve shall be poppet type, fast acting, tolerant to contaminants, and made of stainless steel cartridges.

The direction of rotation of each pump shall be clearly indicated on the pump. DC motor polarity should be clearly identified at the starter. Hydraulic hoses shall be used at suction and pressure for pumps to minimize pulsation and ease of maintenance. Provide 3000 psi rated hydraulic hoses for pressure lines. The hoses will have stainless steel end fittings.

2.4.5 Valves and Accessories

Solenoid Directional control valves shall be used to direct the flow of oil to the operating cylinder at the gate valve. Solenoid configuration shall be such that one coil opens the gate and the other closes the gate and stop when the required position is reached within a set deadband. The speed of operation and deadband should be set in the field to minimize instability issues of the closed loop and to maximize the position accuracy.

All solenoid valves shall be 24 VDC. Solenoid valves shall be poppet type to minimize internal leakage and silting from contamination as a result of staying in one position for long time. Internal leakage should be limited to 5 drops per minute per port to alleviate silting of the valves from oil contamination. Spool type valves shall not be used.

All valves shall be assembled in manifolds to minimize plumbing and to
minimize issues. Manifolds can be aluminum or ductile iron. Manual operation of the actuators shall be possible without PLC in active circuit, but when main power is available. Use separate manual selector valves or detented override on solenoid valves for overriding the PLC or when PLC is in maintenance. Provide Auto/Off/Manual switch at the CHPU. In Manual mode, PLC shall be taken out of the controls.

Dual pilot operated check valves or other suitable means shall be provided to maintain the current position of the cylinder in steady state conditions.

Flow control valves shall be provided and shall be fully adjustable over the desired range of operating speed. Piston pump maximum flow stop may be used to set the base speed.

All system connections to the cylinders shall be terminated at the power unit with ball valves.

Check valves shall be provided to prevent reverse flow through the pumps. They shall also be provided wherever required in the circuit to provide proper operation. Provide check valve at the oil return line from actuators to prevent back pressure effect of one actuator on another.

Hydraulic valves provided with external drain connections shall be piped independently to the reservoir or to a vented manifold.

All other valves and accessories shall be provided as required to meet the necessary performance requirements.

One (minimum 4" dial) Stainless steel pressure gauge is required at the motor starter so that during manual operation of the motors, the operator can see the pressure. Another pressure gauge is required at the control panel side of the CHPU for manual valve operation.

Provide stainless steel isolation valve for the pressure gauges, pressure switches, and pressure transducer.

2.4.6 System Filtration and Contamination Control

Following system filtration techniques shall be utilized as a minimum. There shall be a pressure filter at the common header of all pump supplies. Minimum flow capacity shall be 4 times pump flow rate. Filter efficiency shall be higher than 99% for 10 micron particles. (Filter Beta Ratio for 10 micron particles shall be higher than 750). Filter shall have bypass relief valve and tell-tale condition indicator.

A return filter shall be installed at the return to hydraulic tank. Minimum flow capacity shall be 4 times return flow rate. Filter efficiency shall be higher than 99 percent for 10 micron particles. (Filter Beta Ratio for 10 micron particles shall be higher than 750). Filter shall have bypass relief valve and tell-tale condition indicator.

A Silt filter shall be installed at the kidney loop. Silt filter will be same as the return filter size, as a minimum. Filter efficiency shall be higher than 99 percent for 10 micron particles. (Filter Beta Ratio for 10 micron particles shall be higher than 750), Filter shall have bypass relief valve and tell-tale condition indicator.

Provide a water absorbing/adsorbing filter in the kidney loop to filter
free water in the oil. Filter shall have bypass relief valve and tell-tale condition indicator.

Provide one suction strainer, 100 mesh, for each of the hand pump, kidney loop, and the 12 VDC pump. The suction strainer should have bypass relief and condition indicator. Piston pumps shall not have suction strainers to minimize cavitation issues.

Provide a breather bag bladder for the reservoir. Minimum size is 80 gallon for alleviating entry of moisture and dirt. Use two, 40-gallon size Breather bag bladder and shall be mounted on its own base separately near the CHPU.

Provide a pressure to return bypass needle valve for initial testing of the system. This valve shall be used for troubleshooting system issues by adjusting system pressure in bypass flow mode. In normal operation, this "pressure to return bypass" testing valve will be closed. The valve shall be designed to prevent overheating of the oil. The testing valve operation should not affect the integrity of the breather bag bladder.

System manufacturer shall demonstrate successful installation of the above contamination control techniques with which the oil was kept clean for long period of time (over 5 years at a time before maintenance) in a humid environment with presence of ambient contaminants.

2.4.7 Accumulators

Accumulators shall be sized to provide fluid volume for minimizing pump pressure pulsations. All accumulators shall be built in accordance with the requirements for pressure vessels in ASME Section VIII.

Means shall be provided for safely relieving accumulator gas and liquid pressure. Provide one stainless steel need valve to vent each accumulator to the reservoir. Provide one stainless steel ball valve for isolating each accumulator from the system pressure header. By closing the accumulator isolation valve and opening the needle valve, it shall be possible to isolate any of the accumulators.

Provide two (2), 5 gallon accumulators. Nickel plate the accumulators for corrosion prevention.

The precharge fluid shall be dry nitrogen gas. Precharge nitrogen shall be supplied by the contractor.

An accumulator charging gauge and hose shall be provided and shipped loose. The hose shall have a CGA850 fitting for attaching a nitrogen bottle.

2.4.8 Electrical Controls

All necessary electrical controls, operating devices, and monitoring devices shall be wired to an electrical control enclosure.

The control enclosure shall be stainless steel rated NEMA 4X.

All field connections shall be wired to a terminal strip in the electrical control enclosure.

All control enclosures shall have hinged covers which swing horizontally
and shall be held closed with mechanical fasteners.

Provide required electric motor control and motor starters for all the motors at the CHPU.

2.4.9 Instruments and controls

Provide two PLC's in a single control panel. One PLC is the main and the other shall be standby. Provide a selector switch to choose PLC #1 or PLC #2. Preferred PLC is Siemens S7-300 series or S7-1500 series. Provide necessary power and I/O Modules for the complete operation. A small HMI (Human Machine Interface touch screen) may be used for setting purpose. All modulating controls will be programmed onto a Siemens PLC in the Hydraulic Control Panel.

Command signals for required position of the actuators will be sent from the Flow Control PLC to the PLC at the Hydraulic Control panel which is located at the CHPU. Feedback position signal from each actuator will be sent to the Hydraulic Panel for the modulating controls. Solenoid valves will interface with the PLC to operate the actuators. Controls will be such that:

A 4-20 mA signal to any actuator will modulate that actuator to obtain the desired position at set speed and within the set position deadband.

On loss of command signal, actuator will close automatically.

Valve position transmitter data will be available for remote.

Valve position limit switch information will be available for remote.

Actuator Position limit switch signals shall be wired to the PLC.

Low oil level, high temperature and high pressure will shut down system. Oil level, oil temperature, oil pressure, motor running status, and actuator limit switch status shall be available for remote PLC.

System pressure Gauge shall monitor the normal header pressure. The pressure gauge should be visible when from the motor starter location. Each gauge shall be supplied with a shut-off valve to permit replacement without shutting down the system. Pressure gauge shall be 4 inch diameter stainless steel type.

PART 3 EXECUTION

3.1 INSTALLATION, TESTING AND CLEANING

a) Installation includes the Central Hydraulic Power Unit skid, and Actuators, in addition to interconnecting plumbing and all required electrical wiring. All the field wiring, plumbing, installation, and installation hardware shall be by contractor, but outside the scope of the equipment supplier.

b) Each valve actuator cylinder should be plumbed to the solenoid valves at the CHPU skid. Total of 6 tube lines should be run to the gate valves. The tubing sizes shall not be less than 3/4 inch and should be rated for 3000 psi working pressure with 4 factor of safety. Tube size should be such that the fluid velocity does not exceed 15 feet /second. Tube material should be seamless 316 stainless steel type. Tube fittings shall
be Swagelok type.

c) Connect a 3/4 inch stainless steel tube from the reservoir top at CHPU to the Breather bag bladder. The tube shall be rated for minimum 1000 psi.

d) Tube runs will be supported at regular intervals and should run in parallel to in trays. Installed tubes and pipes shall not rub against each other to alleviate problems from fretting and erosion. Each tube run will terminate at a stainless steel ball valve to isolate the gate valve actuator. A bypass stainless steel ball valve is required for bypassing the cylinder ports to tank, in a manner similar to existing system for the gate valve.

e) Handling of all the field tubing shall be with care to avoid dirt entry into the tubes. DO NOT USE TEFLOM TAPE DURING PLUMBING. USE ONLY HIGH QUALITY PIPE SEALANT TEFLOM PASTE. The sealant shall be supplied by the hydraulic system supplier. The sealant shall be used only for NPT fittings.

f) The Contractor shall test the complete system following installation in order to verify that all components work properly. The system shall run continuously for 2 hours.

g) The manufacturer shall provide as part of this Contract the technical services of a factory trained and certified, authorized field representative to accomplish the following:

h) Equipment shall be installed where shown on the drawings and in accordance with the manufacturer's shop drawings after drawings have been reviewed. Before grouting is done, equipment alignment and installation shall be checked and approved in writing by the factory representative.

i) Start-up Inspection and Supervision. The field representative shall make an inspection prior to actual start-up to approve the assembly readiness and shall then supervise the actual start-up.

3.2 **PAINTING HOIST**

The hoist may be painted with a complete coating system in accordance with the manufacturer's standard practice, in which case it will be exempted entirely from the surface preparation and painting requirement specified herein, provided the coating system is approved by the Government Representative, is of acceptable color and is touched up as necessary prior to shipment. Requests for such exemption shall be accompanied by a description of the manufacturer's standard coating system, including the surface preparation, type of primer and finish coat or coats, dry film thickness and whether baked-on or air-dried.

3.3 **LUBRICATION AND LUBRICANTS**

Prior to testing in the shop, and to initial operation in the field, the gate seat facings and wedging devices shall be cleaned of all foreign material and lubricated thoroughly with a light grease. All lubricants shall be as recommended by the gate manufacturer and shall be submitted by manufacturer's name and number as part of the shop drawings. At no additional expense to the Government, the Contractor shall furnish an additional 20 pounds of each different lubricant.
3.4 SHOP ASSEMBLY AND TESTS

After completion of initial machining, the gate shall be completely assembled, in the vertical position, and the wedging devices adjusted to exclude a 0.004-inch thickness gage between the frame and slide seating surfaces. Any additional machining needed to achieve this condition shall be performed, any discrepancies or deficiencies discovered as a result of this procedure shall be corrected, and a retest conducted. The slide shall be completely opened and closed in the guides several times to ensure that it operates freely. The gate shall then be disassembled to the extent necessary for shipment. The Contractor shall notify the Government Representative sufficiently in advance so that a representative of the Government Representative may witness the assembly, testing and disassembly work, unless this requirement is waived in writing by the Government Representative. Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedied by the Contractor at no additional expense to the Government, and retests conducted.

3.5 FIELD INSTALLATION AND TESTS

3.5.1 Installation

All installation of the gate and appurtenances shall be in accordance with the manufacturer's installation instructions and under the supervision and direction of the erecting engineer specified in paragraph "Erecting Engineer." All elements of the gate shall be cleaned of all protective coating used thereon during shipment and storage, and all rust, dirt, grit and other foreign matter shall be removed. The gate shall then be "touch-up" painted with the standard paint provided by the gate manufacturer. Each element of the gate shall be carefully and accurately aligned so that after it is fastened in place there will be no binding or excessive pressure or wear in any moving part and no distortion of any member. The wall thimble shall be internally braced during concrete placement. Fasteners shall be tightened uniformly and firmly, but care shall be taken not to overstress either the fastened or the member with which it is associated. Where specific torque values or ranges are cited in the installation instructions, an accurately calibrated torque wrench, having the proper capacity range, shall be used. Stilson wrenches, cold chisels or other tools, likely to cause injury to the surface of any part, shall not be used in the work of assembly or tightening. All fasteners shall be installed with an anaerobic locking compound similar or equal to that of the LOCTITE Corporation. Cleaning prior to application of the locking compound and adjustment of the torque valves shall follow the manufacturer's recommendations. All shims shall be of either an epoxy grout or a ready-to-use, non-shrinking grouting material, requiring only mixing with water at the worksite, shall be used, and use of any grouting material shall be as recommended by the manufacturer. All blocking and wedges used for support during initial grouting shall be removed prior to final grouting.

3.5.2 Tests

The gate shall be operated and tested by and at the expense of the Contractor and under the supervision and direction of the erecting engineer to determine if they have been properly manufactured, assembled and installed and if they meet the requirements of the specifications. The Contractor shall notify the Government Representative at least 5 days prior to commencing the testing. In addition, the slide shall be blocked in both directions and the torque limit switch settings checked. After
all adjustments have been properly made, the slide shall be raised and lowered electrically not less than three times. Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedies by the Contractor at no additional expense to the Government, and retests conducted.

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BULKHEAD AND APPURTENANT ITEMS

09/06

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PART 1  GENERAL

1.1  SCOPE

The work provided for herein consists of furnishing all plant, labor, material; and equipment and performing all operations required to the design, materials of construction, fabrication and furnishing the steel bulkhead gate with appurtenant seals, sills, and accessories required for complete and proper operation of the gate, complete with sill beams (including anchor bolts and second pour concrete), embedded side seal plates (including anchor bolts), and any necessary appurtenances and accessories, all as specified herein and as shown on the contract drawings.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  RELATED WORK SPECIFIED ELSEWHERE

a.  Section 03 31 00.00 12 CAST-IN-PLACE STRUCTURAL CONCRETE.

b.  Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

1.4  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1  (2010; Errata 2010) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)


Rubber Products in Automotive Applications


ASTM F593 (2002; R 2008; E 2012) Stainless Steel Bolts, Hex Cap Screws, and Studs


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10 (2007) Near-White Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-16173 (Rev E w/Int Amend 1) Corrosion Preventive Compound, Solvent Cutback, Cold-Application

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

Prior to performing any fabrication on the bulkheads, complete detailed shop drawings for the bulkheads and appurtenant embedded items shall be submitted by the Contractor for approval. Drawings shall show complete details of materials, dimensions, tolerances, proposed welding sequences, location and types of nondestructive weld tests and all details required to locate, assemble, erect, and install the bulkheads, stems, lift and accessories at the job site. Any component part of fabricated items omitted on contract drawings shall be detailed on the shop drawings by the fabricator as well as details specified in related work sections. Detail drawings shall be submitted as specified herein and in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.
SD-03 Product Data

Materials

System of identification which shows the disposition of specific lots of approved materials and fabricated items in the work shall be submitted before completion of the contract.

Materials orders, materials lists and materials shipping bills shall be submitted as specified in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

Welding; G

Schedules of welding procedures for structural steel shall be submitted as specified in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-04 Samples

Materials; G

Samples shall be submitted and approved prior to use of the represented materials or items in the work. Samples of standard and shop fabricated items shall be full size and complete as required for installation in the work. Approved samples may be installed in the work provided each sample is clearly identified and its location recorded. Rubber seal materials and splice samples shall be submitted for inspection and Government Representative approval. Samples shall include a sample of each type of corner splice required. Splices shall be made using the same method, materials and equipment that will be used for seals furnished at the job site. Total length of each splice sample shall be not less than 12 inches long. Samples shall be furnished at least 60 days prior to the installation of rubber seals in the work.

SD-05 Design Data

a. Structural design computations, including disc, UHMW bearing stresses, operating load and lifting beam.

b. All modifications to the civil structure that may be required and any boxout requirements.

Drawings and calculations must bear the stamp of a Registered Professional Engineer, registered in the state where the bulkhead gate is designed and manufactured.

SD-06 Test Reports

Tests, Inspections, and Verifications

Certified manufacturer's test reports shall be provided for rubber seals to verify compliance with the applicable specification and fitness for application. Certified test reports for material tests shall be submitted with all materials delivered to the site.
1.6 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.7 QUALITY CONTROL

The Contractor shall establish and maintain quality control for the work performed under this section of the specifications to assure compliance with contract requirements and shall maintain records of his quality control for all operations including but not limited to the following:

(1) Inspection in the shop for proper materials.
(2) Shop fabrication and assembly.
(3) Non-destructive weld testing of the bulkheads.
(4) Painting.
(5) Preparation for shipment.
(6) Inspection of the worksite for damage to and defects in the bulkheads.
(7) Storage at the worksite.
(8) Trial operation, adjustment of bulkheads, and appurtenant parts.
(9) Installation, alignment and adjustment of the seal plates and angles, seal beams, anchor bolts, washers, and nuts.

1.7.1 Reporting

The original and two copies of these records and tests, as well as the records of corrective action, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.8 SHIPPING

Prior to shipping all machined surfaces and steel surfaces which will be embedded in concrete shall be cleaned of all dirt, rust, weld spatter, and other foreign coatings, not including closely adhering mill scale. Machined surfaces and non-galvanized carbon steel surfaces shall be then coated with a rust preventive meeting the applicable requirements of MIL-PRF-16173 for "Grade 2." This coating shall be removed before the item is embedded in concrete. All small parts and components shall be boxed. All large parts and elements shall be protected by wooden pads, blocking, and other sturdy and suitable arrangements which will prevent damage during loading, shipment, unloading, storage, and subsequent handling. The various elements of the bulkheads shall be provided with lifting connections to facilitate handling during loading, unloading, and erection and installation. The connections shall be so located and reinforced as to prevent warping and misalignment of the bulkheads. Any eyebolts, special slings, strongbacks, and other devices used in loading and handling the gate elements after fabrication in the shop shall be furnished for unloading and handling at the destination.
1.9 TEMPORARY STORAGE

Upon delivery at the worksite, the bulkheads, exclusive of boxed parts and components, shall be stored on blocking not less than 8 inches above a base of sand, shell or gravel. The blocking shall be constructed from material that will not have any detrimental effect on the bulkheads. All boxed parts and components shall be stored in a dry and covered, out of the weather, area. The proposed storage method, site and location shall be submitted to the Government Representative for approval.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Skin Plate

ASTM A572, type 6061-T6.

2.1.2 Structural Angles

The bulkhead structural angles specified and shown on the detail drawings shall be fabricated from steel conforming to the requirements of ASTM A572.

2.1.3 Plate - Structural

The bulkhead end plates, stiffeners, adjustment plates, braces, bearing bars, lift eye plates, and other steel not otherwise indicated or specified shall be fabricated from steel conforming to the requirements of ASTM A572.

2.1.4 Seal Deflection Bars

The seal deflection bars shall be fabricated from corrosion resisting steel ASTM A276, Type 304 as indicated on the drawings.

2.2 STRUCTURAL STEEL

The bulkhead-slot guide angles, bulkhead-slot base WT sections, stiffeners, bars, and other bulkhead- slot steel not otherwise indicated or specified shall be fabricated from steel conforming to the requirements of ASTM A36 or ASTM A992.

2.3 STAINLESS STEEL

2.3.1 Retainer Bars and Bolts for Seals

The seal retaining bars shall be fabricated from corrosion resisting steel conforming to the requirements of ASTM A276 Type 304, Hot or Cold Finish, Condition A, Class C, Type 304. Seal retaining bars and embedded metals shall be as specified in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.2 Fasteners Including Assembly Bolts

All fasteners shall be stainless steel conforming to the requirements of ASTM F593, Type 304 and ASTM F594, Type 304 or ASTM A276, Type 304, as indicated on the drawings.
### 2.3.3 Gate Guide Slots and Seal Surfaces

All guide slots and seal surfaces shall be stainless steel conforming to the requirements of ASTM A276, Type 304 as indicated on the drawings.

### 2.4 BULKHEAD SEALS

Bulkhead seals shall be made of rubber to the shapes, sizes, and dimensions shown on the drawings. The J-seals shall conform to the requirements ASTM D2000, Gr 2BC515. The Invert-seals shall conform to the requirements ASTM D2000, Gr AA625. The rubber seals shall be molded only and the material shall be compounded of natural rubber or a copolymer of butadiene and styrene, or a blend of both and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers. Physical characteristics shall meet the following requirements:

<table>
<thead>
<tr>
<th>PHYSICAL TEST</th>
<th>TEST VALUE</th>
<th>TEST METHOD SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>3000 psi (min)</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>450 percent (min)</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>300% Modulus</td>
<td>900 psi (min)</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Durometer Hardness</td>
<td>60 to 70</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>5 percent by weight (max)</td>
<td>ASTM D471</td>
</tr>
<tr>
<td>Compression Set</td>
<td>30 percent (max)</td>
<td>ASTM D395</td>
</tr>
<tr>
<td>Tensile Strength After Oxygen Bombing Agent</td>
<td>80 percent (min) of tensile strength</td>
<td>ASTM D572</td>
</tr>
</tbody>
</table>

### 2.5 GATE SCHEDULE

All dimensions shown in the gate schedule are for the clear opening.

| Quantity Required | 3 |
| Size in inches (width x height) | 120 IN BY 120 IN |
| Location           | MONOLITH C-7 |
| Design seating head in feet from invert | 10 |
| Design UNseating head in feet from invert | 0 |
| Operating seating head in feet from invert | 10 |
| Operating UNseating head in feet from invert | 10 |
| Top of structure elevation | 5.75 |
| Guide Type (Embedded, In-Channel or Wall) | 3 ASSEMBLIES, IN WALL |
| Normal gate location (in use or stored) | BULKHEAD STORAGE RACK |

### PART 3 EXECUTION

#### 3.1 FABRICATION

The bulkhead manufacturers shall have a minimum of 5 years experience in the design and manufacture of equipment of this type. Except as otherwise specified, all welding, weld tests, inspections and verifications, metalwork fabrication, machine work, assembly, erection and testing shall...
be in accordance with applicable provisions of SECTION 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

3.1.1 Painting

The gate and all exposed steel surfaces shall be blasted to SSPC SP 10 and receive the manufacturer's recommended paint system. Stainless steel metal, rubber seals, bearing surfaces and metalwork of the sill and seal plates that are to be embedded in concrete shall not be painted. Machined surfaces shall be protected as specified in SECTION 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

3.1.2 Rubber Seals

Seals shall be furnished in straight strips, except for specials, of such length that field splicing will be held to a minimum. Upon approval of the Government Representative, seals may be furnished completely or partially fabricated. Splicing shall be done in strict accordance with the recommendations of the manufacturer as approved by the Government Representative. Splices shall have a tensile strength of not less than 50 percent of the unspliced material. All splices shall be vulcanized. Special corner and angle pieces shall be integrally molded or shall be fabricated specials made up of vulcanized splices.

3.1.3 Embedded Metals

Embedded metals including plates, angles, and studs shall be as specified in Section 05 50 03.00 12 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.2 INSTALLATION AND TRIAL OPERATION

3.2.1 Testing and Trial Operation

Upon completion of the bulkhead installation, the bulkhead shall be completely opened and closed several times to ensure that it operates freely. The contractor shall notify the Government Representative at least 5 days prior to commencing the testing. The Contractor shall demonstrate that each bulkhead is operational in its appropriate bulkhead slot. Prior to dry testing, the rubber side seals shall be coated with vegetable soap to reduce dry friction on side seal plates during raising and lowering. During all testing the bulkheads shall be visually inspected to insure that all parts are properly fitted and that seals remain fully in contact with seal plates. Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedied by the Contractor at no additional expense to the Government, and retests conducted.

3.3 STORAGE

Prior to completion of the contract, each bulkhead shall be placed on the bulkhead storage rack.

3.4 TECHNICAL REQUIREMENTS

3.4.1 Operation

Operation shall be by overhead crane.
3.4.2 Design Criteria

3.4.2.1 Gate

The gate shall consist of a smooth skin plate with horizontal and vertical structural reinforcing members and shall be continuously welded throughout to form a box-like structure. The minimum weld size shall be as governed by AWS D1.1. The gate shall be designed to safely withstand the maximum unbalanced head as designated in the paragraph "Gate Schedule". The maximum allowable stress shall be the lesser value of 40 percent of the yield strength and 25 percent of the ultimate strength. The disc deflection shall not exceed 1/1000 of the nominal gate width.

A flat bar shall be welded to the outer periphery of the skinplate and machined to a true plane to provide a mounting surface for the gate seals. The seal support surface shall be within a 0.03 inch overall flatness tolerance. The axle mounting holes in the disc shall be line-bored after fabrication to be parallel to the seal support surface within a 0.005 inch parallelism tolerance. All steel gate components shall have a minimum thickness of 1/4 inch.

When two or more gate sections are necessary, the horizontal splice between the sections shall be machined to a true plane perpendicular to the seal mounting surface. The sections shall be keyed and bolted together to form an integral structural unit. The sections shall be trial assembled in the manufacturer's shop and checked for alignment.

The gate shall have two lifting points designed to interface with the lifting mechanism.

3.4.2.2 Seals

Seals shall be placed along the top, bottom, and both sides of the gate to prevent leakage. The seals shall be attached with stainless steel retainer bars and hardware and attached in a manner to permit replacement of the seals. Top seal corners shall be formed by molded sections. Joints between the molded corners and top or side seals shall be a square butt type located a minimum of 12 inches from the corner. The molded corner shall be bonded to the top and side seal and assembled to the gate in the manufacturer's shop. Side seals shall overlap the bottom seals to form a continuous sealing surface. Mitered joints should not be used.

3.4.2.3 Gate Guide Slots

Prefabricated corrosion resistant steel (CRS) gate guide slots shall be provided to the correct dimensions to ensure proper gate operation including location of the stainless steel sealing surface and structural gate bearing. The CRS sealing surface shall have a maximum 125 micro inch rms. Guides shall be secured in secondary concrete pours or in grout where embedded. Face mounted on in channel guides shall be secured with post installed concrete anchor bolts.

3.4.2.4 Sill

The sill shall consist of a structural steel beam conforming to ASTM A992 with a CRS seating surface. The sill beam will provide an opening flush with the floor of the channel. The stainless steel sealing plate shall have a maximum 125 micro inch rms finish. Concrete anchors with double nuts or other means will be provided to allow for installation and proper
3.4.2.5 Lifting Beam

A lifting beam shall be provided for each bulkhead gate. All components of the beam shall be designed the stresses encountered during the lifting operation of the gate. The beam shall be equipped with a suitable connection for crane operation. The lifting beam shall be guided by the gate guide slot, and shall be capable of securing and releasing the bulkhead gate with the use of a lanyard from the operating floor.

3.4.2.6 Storage Rack

A storage rack shall be provided to store the bulkhead gate in the horizontal position when not in use. The rack shall be as shown at the location identified on the contract drawings.

3.4.2.7 Dogging Pins

Dogging pins shall be provided to secure the bulkhead in the guide slots at the operating floor level.

3.4.2.8 Leakage

Leakage is specified only for the direction of primary use. The maximum permissible leakage shall be 0.2 gallons per minute per foot of sealing perimeter.

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GATE VALVES

08/08

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PART 1   GENERAL

1.1   SCOPE

The work covered by this Section consists of the Contractor furnishing all plant, equipment labor, and materials, and performing all operations in connection with the installation of the gate valves, appurtenant items, and accessories in accordance with these specifications and as shown on the drawings.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.5   Standards of Pipes and Fittings

1.4   SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gate Valves; G

Submit shop drawings and manufacturer data

SD-03 Product Data

Operational and Maintenance Data

The manufacturer shall supply six (6) sets of bound Operating and Maintenance Instruction Manuals and Parts Lists for each different type of valve. The Contractor shall present all sets of the manuals to the Government before final completion of the contract.

1.5   IDENTIFICATION TAGS

On the chain wheel of each valve, the Contractor shall attach a permanent identification tag bearing a number. The tags shall be numbered consecutively from one up, and shall be constructed of brass with black
PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

2.2 VALVE CONNECTIONS

Provide valves suitable to connect to adjoining piping as specified for pipe joints. The valves shall be fully equal in area to the piping on which they are placed. Valve ends, shall match the specified piping as listed by use in the steel pipe section.

2.3 GATE VALVES

Gate valve shall be manually operated manufactured by the Red Valve Company or approved equal and constructed with the following features:

1. The valve shall be made with a cast iron body, with several support ribs for a strong, flanged connection.

2. The valve shall have standard flange holes drilled and tapped meeting M.S.S. SP-81 and ANSI B16.5, Class 125/150 requirements.

3. The valve shall have raised face flanges. Valve shall have all wetted parts of 304 or 316 stainless steel. Stainless steel liner shall extend through the valve chest to the top of the packaging gland. Both sides of the gate shall be finished ground.

4. The valve gate shall be suitable for 150 PSI pressure differential. Packing gland shall have three (3) layers of fiber packing with an elastomer seal.

5. The valve shall be manually operated.

6. Valves shall be painted on its interior and exterior with the same coatings used for the discharge piping.

PART 3 EXECUTION

3.1 VALVE INSTALLATION

Valves shall be placed in the locations indicated on the drawings or at locations designated by the Government Representative. They shall be located and stems or hand wheels placed in positions to provide the best combination of safe operation and proper maintenance with clearance of surrounding equipment and passageways. Valves shall be carefully examined before installation. They shall be installed free from distortion or strain. Where required, supports shall be placed under the bodies. All nuts, bolts, gaskets, anchors, and other appurtenances, shall be provided as specified. Connections shall be made to all operating devices, such as floor stands. When completely installed each valve shall be tested for satisfactory operation, and if found otherwise, it shall be adjusted or replaced. All valves shall be firmly secured to prevent blowout.
3.2 PAINTING

All metal valves exposed to view and all outside metal valves above ground exposed to view shall not be shop coated on the outside unless shop coat is compatible with proposed paint systems and finish coats or proposed insulation. Painting is specified in Section 09 97 02.01 12 PAINTING: COAL TAR EPOXY SYSTEM.

3.3 TESTING

Valves shall be tested in accordance with the requirements for the applicable type of pipe installed.

-- End of Section --
SECTION TABLE OF CONTENTS

DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 31 19.04 12

STONE AND BEDDING CONSTRUCTION

09/07

PART 1   GENERAL

1.1   SCOPE
1.2   MEASUREMENT AND PAYMENT
1.3   REFERENCES
1.4   QUALITY CONTROL
   1.4.1   General
   1.4.2   Reporting

PART 2   PRODUCTS

2.1   MATERIALS
   2.1.1   Bedding
   2.1.2   Graded Stone
      2.1.2.1   General
      2.1.2.2   Sources and Evaluation Testing
      2.1.2.3   Size
   2.2   MVN STANDARD TEST METHOD FOR GRADATION OF STONE
      2.2.1   General
      2.2.1.1   Sample Selection
      2.2.1.2   Selection of Size for Separation
      2.2.2   Procedure

PART 3   EXECUTION

3.1   CONSTRUCTION
   3.1.1   General
   3.1.2   Placement
3.2   GRADE TOLERANCES

-- End of Section Table of Contents --
PART 1  GENERAL

1.1  SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment and materials, and performing all operations in connection with furnishing and placing the bedding layer, graded stone and other incidental work as may be necessary to complete the berm erosion protection as shown on the drawings, and as herein after specified.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES (2006 Edition), LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT (LADOTD)

LSSRB 1003.02 Aggregates for Portland Cement Concrete and Mortar

1.4  QUALITY CONTROL

1.4.1  General

The Contractor shall inspect all materials before they are incorporated into the work for compliance with contract requirements and any material found to be defective will be rejected. All information pertaining to the inspection shall be recorded and included in quality control reports furnished the Government Representative. The Contractor shall establish and maintain quality control for construction operations to assure compliance with contract requirements, and maintain records of his quality control for all construction operations. The quality control reports shall include, but not be limited to, the following:

(1) Equipment. Type, size, and suitability for construction of the prescribed work.

(2) Submission of stone samples for quality testing, if from other than approved sources, as specified in paragraph Sources and
Evaluation Testing.

(3) Quality of stone, and bedding meets the requirements specified.

(4) Quantity of stone, and bedding delivered and placed each day.

(5) Gradation of Stone. Gradation tests of stone shall be accomplished at the quarry. Tests by weight shall be made by the Contractor in the presence of the Government Representative. The Contractor shall notify the Government Representative not less than 3 working days in advance of each test. In the event of nonavailability of the Government Representative, the Contractor shall perform the tests and certify to the Government Representative that the stone shipped complies with the specifications. A minimum of one test shall be performed for each 25,000 tons, or fraction thereof, of stone supplied to the Government from each source. Each test sample shall be representative of the stone being shipped and shall consist of not less than 15 tons. Percentage determinations shall be made for each stone weight specified. Gradation test data shall be recorded on MVN form 602-R "Gradation Test Data Sheet", a copy of which is shown at the end of this section. Failure of the test on the initial sample and on an additional sample will be considered cause for rejection of the quarry and/or quarry process, and all stone represented by the failed tests shall be set aside and not incorporated into the work. Any additional tests required because of the failure of an initial test sample will not be considered as one of the other required tests. Certification and test results shall represent stone shipped from the quarry and must be received by the Government Representative before the stone is used in the work. The Contractor shall designate on the test form that portion (in tons) of the lot tested which is applicable to this contract. Any deviation from the reported tonnage shall be corrected on a revised gradation test form. The Government Representative may direct additional testing of stone furnished to the worksite if the stone appears, by visual inspection, to be of questionable gradation or quality. Refer to paragraph 8 for the gradation test method.

(6) Compliance Surveys. Upon completion of suitable reaches of berm erosion protection, the Contractor shall perform, plot and submit compliance cross section surveys at a maximum of 50 feet intervals, berm transitions and breakpoints. All sections shall be taken at locations corresponding to the Government original survey. They shall be plotted by the Contractor on a minimum scale of 1 inch equals 10 feet horizontally and 1 inch equals 5 feet vertically with the theoretical design cross section and allowable grade tolerances superimposed thereon.

1.4.2 Reporting

The original and two copies of these records, as well as the records of corrective action taken, shall be furnished the Government daily. Format of report shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.
PART 2   PRODUCTS

2.1   MATERIALS

2.1.1   Bedding

Bedding material shall be crushed stone and shall meet the requirements of LSSRB 1003.02(a). The stone source shall be State approved and shall conform to the following gradation:

<table>
<thead>
<tr>
<th>U. S. Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 15</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 2</td>
</tr>
</tbody>
</table>

2.1.2   Graded Stone

2.1.2.1   General

All stone shall be of a hard, durable quality such as will not disintegrate under the elements or be easily broken in handling. It shall be clean and free from earth, dust, or other refuse. The faces of individual pieces of stone shall be roughly angular, not rounded, in shape. Field stone will not be accepted.

2.1.2.2   Sources and Evaluation Testing

Stone shall be obtained from an Government approved source. If the Contractor proposes to furnish stone from a source not approved by Government, the Government will make such investigations as necessary to determine whether acceptable stone can be produced from the proposed source. Satisfactory service records will be acceptable. If no such records are available, the Government will make tests to assure the acceptability of the stone. The tests to which the stone may be subjected will include petrographic analysis, specific gravity, abrasion, unit weight, absorption, wetting and drying, freezing and thawing and such other tests as may be considered necessary by the Government Representative.

The following guidance is provided for use by the Contractor in analyzing a source of stone not approved by Government. Stone that weighs less than 155 pounds per cubic foot or has more than 2 percent absorption will not be accepted unless other tests and service records show that the stone is satisfactory. The method of test for unit weight and absorption will be ASTM C127 except that unit weight will be calculated in accordance with note 5 using bulk specific gravity, S.S.D. Samples of stone from a source shall be submitted to the Government Representative for testing and acceptance prior to delivery of any stone to the site of the work. Samples shall consist of at least seven pieces of stone, roughly cubical in shape and weighing not less than 100 pounds each. All such samples shall be taken by the Contractor under the supervision of the Government Representative. The samples shall be shipped at the Contractor's expense to the Government approved testing laboratory at least 90 days in advance of the time of the placing of the stone is expected to begin. The tests will be conducted in accordance with applicable. The cost of testing will be borne by the Government.

2.1.2.3   Size

Stone shall be in pieces weighing not less than 6 pounds each, nor more
than 200 pounds each. Each shipment shall be graded approximately as follows:

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Grading Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 Pounds to 200 Pounds</td>
<td>5 percent Maximum</td>
</tr>
<tr>
<td>125 Pounds to 149 Pounds</td>
<td>5 percent to 15 percent</td>
</tr>
<tr>
<td>75 Pounds to 124 Pounds</td>
<td>15 percent to 40 percent</td>
</tr>
<tr>
<td>25 Pounds to 74 Pounds</td>
<td>40 percent to 55 percent</td>
</tr>
<tr>
<td>Under 25 Pounds</td>
<td>10 percent Maximum</td>
</tr>
</tbody>
</table>

2.2 MVN STANDARD TEST METHOD FOR GRADATION OF STONE

2.2.1 General

2.2.1.1 Sample Selection

The most important part of the test and the least precise is the selection of a representative sample. No "standard" can be devised; larger quarry run stone is best sampled at the shot or muck pile by given direction to the loader; small graded stone is best sampled by random selection from the transporting vehicles. If possible, all parties should take part in the sample selection, and agree before the sample is run, that the sample is representative.

2.2.1.2 Selection of Size for Separation

It is quite possible and accurate to run a gradation using any convenient sizes for separation, without reference to specifications. After the test is plotted on a curve, then the gradation limits may be plotted. Overlapping gradations with this method are no problem. It is usually more convenient, however, to select points from the gradation limit, such as the minimum 50 percent size, the minimum 15 percent size, and one or two others, as separate points.

2.2.2 Procedure

(1) Select a representative sample (See paragraph "Sample Selection"), weigh and dump on hard stand.

(2) Select specific sizes (see example) on which to run "individual weight larger than" test. Procedure is similar to the standard aggregate gradation test for "individual weight retained".

(3) Determine the largest size stone in the sample. (100 percent size).

(4) Separate by "size larger than" the selected weights, starting with the larger sizes. Use reference stones, with identified weights, for visual comparison in separating the obviously "larger than" stones. Stones that appear close to the specific weight must be individually weighed to determine size grouping. Weigh each size group, either individually or cumulatively.

(5) Subparagraph .(4) will result in "individual weight retained" figures. Calculate individual percent retained (heavier than) and cumulative percent retained and cumulative percent passing (lighter than). Plot percent passing, along with the specification limits and fill-in and document test on applicable form to be provided by the
EXAMPLE GRADATION

SPECIFICATIONS

STONE WEIGHT IN LBS.  INDIVIDUAL PERCENT RETAINED

<table>
<thead>
<tr>
<th>Stone Weight</th>
<th>Specified Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 - 125</td>
<td>10 max.</td>
</tr>
<tr>
<td>25 - 74</td>
<td>40 - 60</td>
</tr>
<tr>
<td>6 - 24</td>
<td>20 - 40</td>
</tr>
<tr>
<td>&lt; 6</td>
<td>15 max.</td>
</tr>
</tbody>
</table>

EXAMPLE WORKSHEET

<table>
<thead>
<tr>
<th>Stone Weight</th>
<th>Individual Weight</th>
<th>Individual % Retained</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>+125</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>75 - 125</td>
<td>2,600</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>25 - 74</td>
<td>16,200</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>6 - 24</td>
<td>10,000</td>
<td>25</td>
<td>90</td>
</tr>
<tr>
<td>&lt; 6</td>
<td>3,200</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>32,000 lbs.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Largest stone 125 lbs.

PART 3 EXECUTION

3.1 CONSTRUCTION

3.1.1 General

The bedding and graded stone shall be placed within the limits, lines, grades, and sections shown on the drawings.

3.1.2 Placement

The large stone shall be well distributed throughout the mass and the finished structure shall be free from pockets of small stone and clusters of larger stone. Excavation for floating plant on the protected or flood side of the levee will not be permitted. The Contractor shall take measures to minimize the duration of exposure of bedding to wave action so as to minimize bedding displacement. Where bedding has been displaced, the Contractor shall restore the area to design grade and section at no additional cost to the Government.

3.2 GRADE TOLERANCES

All berm erosion protection work shall be constructed to the design grades and sections shown on the drawings. For bedding at all points, a tolerance of plus three inches will be allowed in the design grades and sections. For graded stone, at all points, a tolerance of plus six inches will be allowed in the design grades and sections. Material that is placed outside the allowable tolerance will not be paid for.

-- End of Section --
PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT
1.2 REFERENCES
1.3 DEFINITIONS
  1.3.1 Drainage Aggregate
  1.3.2 Fill
  1.3.3 Reinforced Fill
  1.3.4 Retained Fill
  1.3.5 Reinforcement
  1.3.6 Long Term Design Strength
1.4 SUBMITTALS
1.5 QUALITY ASSURANCE
  1.5.1 Manufacturer Representative
  1.5.2 Detailed Drawings
  1.5.3 Classification of soil materials
1.6 DELIVERY, STORAGE, AND HANDLING
  1.6.1 Labeling
  1.6.2 Handling
  1.6.3 Storage

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  2.1.2 Geotextile Reinforcement
  2.1.3 Reinforcement Properties
    2.1.3.1 Primary Reinforcement Properties
    2.1.3.2 Long Term Design Strength
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2.3 SOILS AND AGGREGATES
2.4 DRAINAGE PIPE
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3.7.4 Testing Schedule  

3.8 REINFORCEMENT TESTING  

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3.10 SEEDING  

3.11 CONSTRUCTION TOLERANCES  

3.12 PROTECTION OF WORK  

-- End of Section Table of Contents --
## PART 1  GENERAL

### 1.1  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

### 1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)**

<table>
<thead>
<tr>
<th>Publication</th>
<th>Description</th>
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**ASTM INTERNATIONAL (ASTM)**

<table>
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<tr>
<th>Publication</th>
<th>Description</th>
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<tbody>
<tr>
<td>ASTM D1556</td>
<td>(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method</td>
</tr>
<tr>
<td>ASTM D2487</td>
<td>(2011) Soils for Engineering Purposes (Unified Soil Classification System)</td>
</tr>
<tr>
<td>ASTM D4355</td>
<td>(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus</td>
</tr>
<tr>
<td>ASTM D448</td>
<td>(2012) Sizes of Aggregate for Road and Bridge Construction</td>
</tr>
<tr>
<td>ASTM D4491</td>
<td>(1999a; R 2009) Water Permeability of Geotextiles by Permittivity</td>
</tr>
<tr>
<td>Standard / Reference</td>
<td>Details</td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>ASTM D4873</td>
<td>(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples</td>
</tr>
<tr>
<td>ASTM D5321</td>
<td>(2012) Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method</td>
</tr>
<tr>
<td>ASTM D698</td>
<td>(2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))</td>
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**GEOSYNTHETIC INSTITUTE (GSI)**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Details</th>
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<tbody>
<tr>
<td>GSI GRI GG6</td>
<td>(1996) Grip Types for Use in Wide Width Testing of Geotextiles and Geogrids</td>
</tr>
<tr>
<td>GSI GRI GT6</td>
<td>(1992) Geotextile Pullout</td>
</tr>
</tbody>
</table>

**NATIONAL CONCRETE MASONRY ASSOCIATION (NCMA)**

<table>
<thead>
<tr>
<th>Reference</th>
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<tbody>
<tr>
<td>NCMA TR127</td>
<td>(2010b) Design Manual for Segmental Retaining Walls</td>
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**U.S. ARMY CORPS OF ENGINEERS (USACE)**

<table>
<thead>
<tr>
<th>Reference</th>
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<tbody>
<tr>
<td>EM 385-1-1</td>
<td>(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual</td>
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**U.S. DEPARTMENT OF AGRICULTURE (USDA)**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Details</th>
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<tbody>
<tr>
<td>AMS Seed Act</td>
<td>(1940; R 1988; R 1998) Federal Seed Act</td>
</tr>
</tbody>
</table>

**U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Details</th>
</tr>
</thead>
</table>
1.3 DEFINITIONS

1.3.1 Drainage Aggregate

Granular soil or aggregate which is placed in or around drains.

1.3.2 Fill

Soil or aggregate placed in, behind, or below the embankment or slope will be referred to as fill.

1.3.3 Reinforced Fill

Soil which is placed and compacted within the neat line volume of reinforcement as outlined on the plans.

1.3.4 Retained Fill

Soil which is placed and compacted behind the reinforced fill

1.3.5 Reinforcement

Reinforcement consisting of a geogrid or a geotextile product manufactured for use as reinforcing. Reinforcement does not include steel products.

1.3.6 Long Term Design Strength

The long term design strength (LTDS) is:

\[
LTDS = \frac{T_{\text{ult}}}{R_{\text{DF}} \times R_{\text{ID}} \times R_{\text{CR}}}
\]

where:

- \(T_{\text{ult}}\) is the ultimate strength
- \(R_{\text{DF}}\) is the reduction factor for chemical and biological durability
- \(R_{\text{ID}}\) is the reduction factor for installation damage
- \(R_{\text{CR}}\) is the reduction factor for creep

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detailed Drawings; G
Shoring

SD-03 Product Data

Geotextile Reinforcement
Field Testing Results
Calculations; G

SD-04 Samples
Reinforcement

SD-07 Certificates

Certificates of Compliance

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer Representative

Provide a qualified and experienced representative from the reinforcement manufacturer available on an as-needed basis during the construction. The representative shall visit the site for consultation at least once during construction as requested by the Government Representative.

1.5.2 Detailed Drawings

Submit the fabrication and installation drawings indicating fabrication and erection details for the slope, including sequencing and construction procedures. If approved by the Government Representative, shop drawings may consist of marked up contract drawings showing exact dimensions for the reinforcement supplied, and other minor revisions. The design and layout of the internal reinforcement shall be subject to the following:

a. All features indicated in the contract documents shall be incorporated in the final design and construction.

b. Each reinforcement level shall run as continuous as practical throughout the profile. If a geotextile filter is present, the reinforcement shall be laid out so that interference with the geotextile is minimized.

c. Any reinforcement not placed with the machine direction as the design reinforcement direction shall be identified on the shop drawings.

1.5.3 Classification of soil materials

Classification of soil materials shall be performed by the Contractor in accordance with ASTM D2488. The Government Representative reserves the right to revise the Contractor classifications. In the case of disagreement, the Government Representative classification will govern unless the soils are classified in accordance with ASTM D2487. All testing completed by the Contractor in conjunction with soil material classification will be considered incidental to the contract work.

1.6 DELIVERY, STORAGE, AND HANDLING

Check products upon delivery to assure that the proper material has been received and is undamaged. Protect the materials from damage and exposure following the guidelines presented in ASTM D4873.

1.6.1 Labeling

Label each roll with the manufacturer's name, product identification, roll dimensions, lot number, and date manufactured.

1.6.2 Handling

Geosynthetic rolls shall be handled and unloaded by hand, or with load
carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Geosynthetic rolls shall not be dragged, lifted by one end, lifted by cables or chains, or dropped to the ground.

1.6.3 Storage

Protect geosynthetics from cement, paint, excessive mud, chemicals, sparks and flames, temperatures in excess of 160 degrees F, and any other environmental condition that may degrade the physical properties. If stored outdoors, elevate the rolls from the ground surface. Protect geosynthetics, except for extruded grids, with an opaque waterproof cover. Deliver geosynthetics to the site in a dry and undamaged condition. Geotextiles shall not be exposed to direct sunlight for more than 7 days.

PART 2 PRODUCTS

2.1 REINFORCEMENT

Submit Certificates of Compliance for the materials; and calculations of the long term design strength for the reinforcement in accordance with the NCMA TR127 or FHWA SA-96-071. Submit an affidavit certifying that the reinforcement meets the project specifications. The affidavit shall be signed by an official authorized to certify on behalf of the manufacturer and shall be accompanied by a mill certificate that verifies physical properties were tested during manufacturing and lists the manufacturer's quality control testing. The documents shall include a statement confirming that all purchased resin used to produce reinforcement is virgin resin. The mill certificate shall include the tensile strength tested in accordance with either ASTM D4595 or ASTM D6637. The ultimate strength or index strength shall be based on the minimum average roll value tensile strength of the product using the wide width strength test in ASTM D4595 or the single rib test in ASTM D6637. The calculation shall itemize each reduction factor and include backup data to justify each reduction factor. Demonstrate splice efficiency from testing, if used. Submit samples of each type of reinforcement. The samples shall be labeled and have a minimum size 8 by 10 inches. Geogrid shall include at least 2 apertures in each direction.

2.1.1 Geogrid Reinforcement

Provide geogrid which is a geosynthetic manufactured for reinforcement applications. The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil, aggregate, or other fill materials. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. The geogrid shall be manufactured with 100 percent virgin resin consisting of polyethylene, polypropylene, or polyester, and with a maximum of 5 percent in-plant regrind material. Polyester resin shall have a minimum molecular weight of 25,000 and a carboxyl end group number less than 30. Polyethylene and polypropylene shall be stabilized with long term antioxidants.

2.1.2 Geotextile Reinforcement

Submit descriptive technical data on the reinforcement and geotextile filter materials. Include all material properties specified under paragraph "PRODUCTS". Geotextile shall be a pervious sheet of polymeric
material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyethylene, polypropylene, or polyesters. The geotextile shall be manufactured with 100 percent virgin resin, and with a maximum of 5 percent in-plant regrind material. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages. Polyester resin shall have a minimum molecular weight of 20,000 and a carboxyl end group number less than 50. Polyethylene and polypropylene shall be stabilized with long term antioxidants. For survivability during installation, and in addition to installation damage used in calculating the long term design strength, the geotextile shall meet the minimum requirements in AASHTO M 288 Class 1, and shall have a minimum mass per unit area of 8 oz/sy.

2.1.3 Reinforcement Properties

2.1.3.1 Primary Reinforcement Properties

The reinforcement shown on the contract drawings shall meet the property requirements listed in Table 1. Reinforcement strength requirements represent minimum average roll values in the machine direction.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>REQUIREMENT</th>
<th>TEST DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Term Design Strength</td>
<td>1450 lb/ft. minimum</td>
<td>NCMA TR127, Method A</td>
</tr>
<tr>
<td>UV Resistance</td>
<td>95 percent after 500 hours</td>
<td>ASTM D4355</td>
</tr>
</tbody>
</table>

2.1.3.2 Long Term Design Strength

Base the long term design strength on reduction factors for installation damage and durability that are applicable to the fill that will be used. Minimum reduction factors for durability include: 1.1 for polyethylene and polypropylene geosynthetics, 1.15 for coated polyester geogrids, and 1.6 for polyester geotextiles.

2.1.4 Reinforcement Splices

Splices in reinforcement shall consist of a standard method or device recommended and approved by the manufacturer of the reinforcing. Splices shall be not less than 90 percent efficient (width wide tensile strength of splice to mean average roll value tensile strength of reinforcing). The splice efficiency shall be demonstrated from testing and shall be submitted. Splicing may consist of overlaps, fusion wedge welding, sewing, or bodkin connections. Splicing methods that are dependent on installer experience and skill level, such as hot air and torch-applied open flame, are not acceptable. Sewing shall include 2 lines of stitching with a Federal 401 double thread lock stitch with a thread of the same polymer type and UV protection as the geotextile. Overlaps shall be separated by 2 inches of soil.

2.2 GEOTEXTILE FILTER

Geotextiles used as filters shall meet the requirements specified in
Table 2. The property values (except for AOS) represent minimum average roll values (MARV) in the weakest principal direction. For survivability during installation, the geotextile shall meet the minimum requirements in AASHTO M 288 Class 3, and shall have a minimum mass per unit area of 8 oz/sy.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST REQUIREMENT</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile</td>
<td>160 lbs. (700N)</td>
<td>ASTM D4632</td>
</tr>
<tr>
<td>Apparent Opening Size</td>
<td>150 - 212 um - 100 U.S.</td>
<td>ASTM D4751</td>
</tr>
<tr>
<td></td>
<td>Sieve</td>
<td></td>
</tr>
<tr>
<td>UV Resistance</td>
<td>70 percent after 500 hours</td>
<td>ASTM D4355</td>
</tr>
<tr>
<td>Permittivity, sec⁻¹</td>
<td>1.5</td>
<td>ASTM D4491</td>
</tr>
</tbody>
</table>

2.3 SOILS AND AGGREGATES

All material placed as fill shall consist of material classified by ASTM D2487 as GW, GP, GC, GM, SP, SM, SC, CL, ML, or SW. The material shall be free of ice; snow; frozen earth; trash; debris; sod; roots; organic matter; contamination from hazardous, toxic or radiological substances; or stones larger than 3 inches in any dimension. Each material shall be obtained entirely from one borrow source, unless the Government Representative determines that quality control is adequate and the alternate source produces material that is similar in gradation, texture, and interaction with the reinforcement. All materials shall be of a character and quality satisfactory for the purpose intended.

a. Reinforced Fill. Soil placed in the reinforced fill zone shall consist of granular material with less than 35 percent passing the No. 200 sieve.

b. Retained Fill. Soil placed in the retained fill zone shall meet the minimum requirements above.

c. Drainage Aggregate shall meet the requirements of ASTM D448, size No.7.

2.4 DRAINAGE PIPE

The drainage pipe shall be corrugated polyethylene pipe meeting requirements of AASHTO M 252.

2.5 SEED

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for mixture percentage, purity, germination, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.
PART 3 EXECUTION

3.1 SHORING

Construct shoring in accordance with the safety requirements of EM 385-1-1. Submit plans and design computations for all shoring used at least 30 days prior to installation. The Contractor is responsible for design and maintenance of all shoring to be installed. Unless otherwise authorized, all sheeting and bracing shall be removed when backfill is completed.

3.2 EARTHWORK

The reinforced fill zone shall bear on undisturbed native soils, or acceptably placed and compacted fill. In the event that it is necessary to remove material or place fill below the excavation lines shown on the drawings, or not otherwise provided for in the contract, the Government Representative shall be notified prior to work and an adjustment in the contract price will be considered in accordance with the contract. Additional work not authorized by the Government Representative shall be at the Contractor's expense.

3.2.1 Excavation

Excavate foundation soil to the lines and grades shown on the construction drawings, and as required for reinforcement placement. Stockpile material for backfilling in a neat and orderly manner at a sufficient distance from the banks of the excavation to avoid overloading and to prevent slides or caving. Perform excavation and fill in a manner and sequence that will provide proper drainage at all times. The Contractor is responsible for disposal of surplus material, waste material, and material that does not meet specifications, including any soil which is disturbed by the work operations or softened due to exposure to the elements and water.

3.2.2 Stockpiles

Stockpiles of all material to be incorporated into the work shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed. Topsoil shall be stockpiled separately from suitable backfill material. Stockpiles of aggregates and granular soils shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes frozen, saturated, intermixed with other materials, or otherwise out of specification or unsatisfactory for the use intended, such material shall be removed and replaced with new material from approved sources at no additional cost to the Government.

3.3 SUBGRADE PREPARATION

Do not place material on surfaces that are muddy, frozen, contain frost, or where unsatisfactory material remains in or under the fill. For cohesionless soils, the subgrade surface shall be compacted with the same compactor and rolling pattern to be used for compaction of the fill. For cohesive soils, the subgrade shall be proof rolled with rubber tired equipment and any soft areas shall be brought to the Government Representative's attention.
3.4 REINFORCEMENT INSTALLATION

a. Before placing reinforcement, compact the subgrade or subsequent lift of fill and level-grade it. The surface shall be smooth and free of windrows, sheepsfoot impressions, and rocks.

b. Reinforcement shall be placed at the elevations and to the extent shown on the construction drawings and the approved shop drawing submittal. Orient the reinforcement with the design strength axis perpendicular to the slope face. Place reinforcement strips immediately next to adjacent strips to provide 100 percent coverage.

c. Install the reinforcement in tension. The reinforcement shall be pulled taut and anchored with staples or stakes prior to placing the overlying lift of fill. The tension shall be uniform along the length of the slope and consistent between layers.

d. All reinforcement shall be 100 percent covered by soil so that reinforcement panels do not contact in overlaps. Where the slope bends, a veneer of fill shall be placed to a nominal thickness of 3 inches to separate overlapping reinforcement.

e. Splicing. Splicing shall not be allowed unless identified on the shop drawings. Splicing shall be limited to only one splice per reinforcing strip and no two consecutive reinforcing strips shall include a splice. Splices shall be located randomly without a pattern. Individual reinforcing lengths less than 10 feet shall be discarded. Seams shall be placed facing upward for inspection purposes.

3.5 FILL PLACEMENT

a. Reinforced fill shall be placed from the slope face back toward the fill area to ensure that the reinforcement remains taut. Fill shall be placed, spread, and compacted in such manner that minimizes the development of wrinkles in or movement of the reinforcement.

b. A minimum fill thickness of six (6) inches is required prior to operation of vehicles over the reinforcement. Sudden braking and sharp turning shall be avoided. Tracked equipment shall not turn within the reinforced fill zone to prevent tracks from displacing the fill and damaging the reinforcement. Construction equipment shall not be operated directly upon the reinforcement as part of the planned construction sequence. Rubber tired equipment may operate directly on the reinforcement if the travel is infrequent, equipment travels slow, turning is minimized, and no damage or displacement to the reinforcement is observed.

c. At the end of each day, slope the last lift of fill away from chimney drains in a manner that will allow drainage and direct runoff away from aggregate.

3.6 COMPACTION

Fill shall not be placed on surfaces that contain mud, frost, organic soils, fill soils that have not met compaction requirements, or where the Government Representative determines that unsatisfactory material remains in or under the fill. Fill shall be spread and compacted in 12 inch lifts.
3.6.1 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698. The maximum density is hereafter abbreviated as the "Standard Proctor" value.

3.6.2 Moisture Control

Control of moisture in the fill shall be maintained to provide acceptable compaction. Disking and plowing will not be allowed in the reinforced fill zone. Moisture content of cohesive soils shall be adjusted at the borrow source before placement. Adding water directly to the reinforced fill zone shall only be conducted under conditions where the soil has sufficient porosity and capillarity to provide uniform moisture throughout the fill during compaction.

3.6.3 Compaction

Reinforced and retained fill shall be compacted to 95 percent of the Standard Proctor Density.

3.7 SOIL TESTING

3.7.1 General

All testing expenses shall be the Contractor's responsibility. Prior to sampling and testing the work, testing laboratories shall be inspected and approved in accordance with Section 01 45 02.00 10 QUALITY CONTROL SYSTEM. The Government Representative reserves the right to direct the location and select the material for samples to be tested and to direct where and when moisture-density tests shall be performed. Nuclear density testing equipment shall be used in general accordance with ASTM D6938.

3.7.2 Transmittal

Inform the Government Representative of test results daily for direction on corrective action required. Draft copies of field testing results shall be furnished to the Government Representative on a frequent and regular basis, as directed. Submit testing data specific to the reinforcement to be supplied:

a. The coefficient for direct shear of the reinforcement on a soil similar in gradation and texture to the material that will be used for fill in the reinforced zone shall be established in accordance with ASTM D5321.

b. The coefficient of interaction for pull-out resistance of the reinforcement in a soil similar in gradation and texture to the material that will be used for fill in the reinforced zone shall be established in accordance with ASTM D6706 or GSI GRI GT6.

3.7.3 Corrective Action

Tests of materials which do not meet the contract requirements (failing test) will not be counted as part of the required testing. Each such failing test must be retaken at the same location as the failing test was taken. If testing indicates material does not meet the contract requirements, the material represented by the failing test shall not be placed in the contract work or shall be recompacted or removed. The
quantity of material represented by the failing test shall be determined by the Government Representative up to the quantity represented by the testing frequency. The Contractor may increase testing frequency in the vicinity of a failing test in order to reduce removal requirements, as approved by the Government Representative. Such increases in testing frequency shall be at the Contractor's expense and at no additional cost to the Government.

3.7.4 Testing Schedule

a. Moisture-Density Relations (ASTM D698)
   One test for each material variation.

b. In-Place Densities (ASTM D1556 or ASTM D6938)
   Not less than 1 test for each 2 vertical feet/300 linear feet along slope face.

c. Sieve Analysis, (ASTM C136)
   Drainage Aggregate, 1 test for each source.

3.8 REINFORCEMENT TESTING

All testing expenses shall be the Contractor's responsibility. Testing shall be performed by a commercial testing laboratory selected by the Contractor and approved by the Government Representative or performed by the Contractor if approved by the Government Representative. The Government Representative reserves the right to direct the location and select the material for samples.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST DESIGNATION</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide Width Strip Tensile</td>
<td>ASTM D4595</td>
<td>1 Test for each source</td>
</tr>
<tr>
<td>Strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Rib Tensile Strength</td>
<td>ASTM D6637</td>
<td>1 Test for each source</td>
</tr>
</tbody>
</table>

ASTM D4595 shall be modified for geogrids considering recommendations in GSI GRI GG6; and the tensile strength shall be expressed on a unit length basis by substituting n*a for Ws, where:

Ws = specimen width, (inches)

n = number of ribs in the sample (must be a whole number)

a = nominal rib spacing for the product tested, (inches)

3.9 DRAINAGE PIPE

Drain pipe shall be placed as indicated on the drawings. Drain lines shall be laid to true grades and alignment with a continuous fall in the direction of flow. The interior of the pipe shall be kept clean from soil and debris; and open ends shall be temporarily capped as necessary.
3.10 SEEDING

Seed shall be applied at the rate of 10 square yards per pound of seed. The seed shall be evenly distributed by hand or using broadcast seeders. Seed shall be covered to a nominal 1/2 inch depth by rakes.

3.11 CONSTRUCTION TOLERANCES

a. Horizontal: The slope crest and toe shall be within 6 inches of the plan location.

b. Vertical: The slope crest elevations shall be within 0.3 feet above to 0.3 feet below the prescribed elevations shown on the drawings.

3.12 PROTECTION OF WORK

Work shall be protected against damage from subsequent operations.

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1.3   REFERENCES
1.4   QUALITY CONTROL
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   1.4.2   Reporting
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1.6   PAVEMENT ACCEPTANCE TESTING
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment and materials (including concrete), and performing all operations in connection with foundation preparation; forming, placing, curing and testing of concrete; sealing joints; and placing miscellaneous backfill as shown on the drawings and as hereinafter specified.

1.2   MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM C231  (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method


ASTM C618  (2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete


ASTM D3406  (2000) Joint Sealant, Hot Poured, Elastomeric Type, for Portland Cement Concrete Pavements

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44  (2013) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 100  (1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing

COE CRD-C 400  (1963) Requirements for Water for Use in Mixing or Curing Concrete

LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES (2006 Edition), LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT (LADOTD)

LSSRB 1003.02  Aggregates for Portland Cement Concrete and Mortar

CONCRETE PLANT MANUFACTURER'S BUREAU (CPMB)

CPMB-01.9  (Jan 1990)Concrete Plant Standards 9th Revision
1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control and records thereof for pavement operations to assure compliance with contract requirement for all construction operations including but not limited to the following:

1. Preparing concrete foundations.
2. Checking batching equipment for accuracy at least once a month in accordance with requirements of NIST HB 44.
3. Obtaining samples of aggregates in accordance with ASTM D75 and testing in accordance with ASTM C136 one week before, and daily intervals during production.
4. Setting of forms and expansion joints, chipping and wire brushing of construction joints and checkout just prior to concrete placement.
5. Batching, mixing, conveying, placing, finishing, curing and protecting concrete, and sealing joints.
6. Molding of concrete cylinders as specified in paragraph "Compressive Strength."
7. Determining air content, slump and concrete temperature in accordance with ASTM C231, ASTM C143, and ASTM C1064, respectively, as well as recording air temperature. These tests shall be performed and recorded every time cylinders are molded and more often as needed for Quality Control.
8. Recording number, dimensions and locations of cores referenced to levee centerline or baseline stationing.
9. Recording location and amount of pavement less than 3 inches in thickness or less than 1200 psi which is removed, and disposition of removed concrete.

1.4.2 Reporting

The original and two copies of quality control records, as well as the records of corrective action taken shall be furnished to the Government daily. The report format shall be as prescribed in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

1.5 DEFINITIONS

As used in this section are as follows:

"Pavement" refers to "concrete slope pavement".
"Existing Old Pavement" is in place pavement that is not part of this contract.

"Existing New Pavement" is in place pavement that is part of this contract.

"New Pavement" is pavement that is intended to be placed on any given day.

"Cold Joint" refers to a joint caused when a placement of concrete cannot be mixed homogeneously with adjacent previously placed concrete.

"Batture" refers to the area between the floodside levee toe and the top of the riverbank.

"Embankment Material" is as specified in Section 31 24 00.00 12 EMBANKMENT, paragraph "Materials."

1.6 PAVEMENT ACCEPTANCE TESTING

1.6.1 Thickness

Slabs shall have a minimum thickness of 4 inches. Variations from this will be paid in accordance with paragraph "PAYMENT". The pavement shall be cored in accordance with ASTM C42 to check its thickness except that 2 inch diameter cores shall be acceptable. After the required curing period, a core shall be obtained for every 200 squares (100 square feet per square) of pavement at locations and time intervals to be determined by the Government Representative. Samples shall be obtained and the core holes refilled with a 2000 psi compressive strength concrete or grout mix in the presence of the Government Representative. Cores will be measured by the Government Representative in accordance with ASTM C174. If the sample reveals a thickness of less than 3-1/2 inches, the result shall apply to the adjacent 20 squares only. The remaining 180 squares will then be cored in groups of 20 at locations directed by the Government Representative.

1.6.2 Compressive Strength

Companion sets, each consisting of 3 concrete cylinders, shall be prepared by the Contractor in accordance with ASTM C31 in the presence of the Government Representative. A companion set shall be prepared for every 100 cubic yards placed and for any additional fraction greater than or equal to 50 cubic yards placed or not less than once a day if less than 100 cubic yards per day are placed. They shall be clearly labeled on the sides of the cylinder molds, initially cured according to ASTM C31 paragraphs 9.1 and 9.2, and protected and transported by the Contractor to the Government testing laboratory according to ASTM C31. Cylinders should be delivered to details for private lab contracted by the Government. The cylinders will be tested by the Government at Government expense. One cylinder will be tested at 7 days for information. The other two companion cylinders will be tested at the age of 28 days (90 days if pozzolan is used) and averaged to determine payment.
PART 2   PRODUCTS

2.1   MATERIALS

2.1.1   Cementitious Material

Cementitious material shall be portland cement, portland pozzolan cement or portland cement in combination with pozzolan or ground granulated blast-furnace (GGBF) slag and shall conform to appropriate specifications listed herein. Cementitious materials will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports, stating that materials meet the requirements of this specification. Certification and mill test reports shall be from current production and shall be representative of materials furnished.

2.1.1.1   Portland Cement

Portland cement shall conform to ASTM C150, Type I low alkali or Type II low alkali, except that the maximum amount of C3A in Type I cement shall be 15 percent.

2.1.1.2   Portland Pozzolan Cement

Portland-pozzolan cement shall conform to ASTM C595, Type IP with Table 2 mortar expansion limits.

2.1.1.3   Pozzolan

Pozzolan shall conform to ASTM C618, Class C or F, with the low alkali requirement of Table 1A and the requirements for multiple factor.

2.1.1.4   Ground Granulated Blast-Furnace (GGBF) Slag

GGBF Slag shall conform to ASTM C989, Grade 120.

2.1.2   Air Entraining Admixture

Air-Entraining Admixture shall conform to ASTM C260.

2.1.3   Water Reducing Or Retarding Admixtures

Water Reducing or retarding admixtures shall conform to ASTM C494, Type A, B or D.

2.1.4   Aggregates

The aggregate sources shall be approved by the Government and should be capable of producing materials of a quality acceptable for this project. Proposed materials produced from similar strata, or of similar quality as those originally tested, will be approved. If the Contractor proposes to furnish aggregates from a source previously approved by the Government, samples consisting of not less than 500 pounds of each size coarse aggregate and 300 pounds of fine aggregate taken under the supervision of the Government Representative in accordance with COE CRD-C 100 shall be delivered to the State approved testing laboratory, within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. From 90 to 120 days will be required to complete evaluation of the aggregates. Testing by and at the expense of the Government will be in accordance with the applicable ASTM test methods.
Tests to which aggregate may be subjected are specific gravity, absorption, freezing and thawing in concrete, alkali aggregate reaction, organic impurities and any other test necessary to demonstrate that the aggregate is of a quality which is at least equivalent to those produced by the sources approved by the Government. Quality of all aggregates shall conform to the requirements of ASTM C33. The grading of the aggregates as delivered to the mixer shall conform to LSSRB 1003.02 or ASTM C33. The nominal maximum size coarse aggregate shall be 1 inch.

2.1.5 Water

Water for mixing shall be fresh, clean and drinkable, except that undrinkable water may be used if it meets the requirements of COE CRD-C 400. Water for washing aggregate and for curing shall not contain any substance that is injurious to the concrete.

2.1.6 Concrete

The concrete shall be composed of portland cement, an air entraining admixture, water, and fine and coarse aggregates. The use of pozzolan or a water reducing admixture is optional. The amount of pozzolan shall range between 20 and 40 percent of the total cementitious material by absolute volume. The Contractor shall provide a mix design which will produce concrete with a compressive strength of 2000 psi at 28 days (90 days if pozzolan is used). The air content shall be 5.5 plus or minus 1.5 percent of the volume of the concrete. The slump shall be suitable for placing concrete on sloping surfaces as shown on the drawings. Concrete mixture proportions shall be submitted for review at least three weeks before concrete work begins. The proportions, types and sources of all ingredients and nominal maximum coarse aggregate size shall be stated. No substitution shall be made in the source or type of materials used in the work without submitting additional data showing that the new materials and quality of concrete are satisfactory.

2.1.7 Membrane Forming Curing Compound

Membrane forming curing compound shall conform to ASTM C309, Type 2.

2.1.8 Forms

Forms shall be constructed of wood, steel, or other approved materials which are straight, free from warp and of sufficient strength when staked to resist the pressure of the concrete without springing in excess of 1/4 inch in 10 feet. The form surfaces shall be smooth, free from irregularities, dents, sags, or holes.

2.1.9 Form Release Agent

Form release-agent shall be a formulation of satisfactory and proven performance that will not bond with, or adversely affect concrete surfaces and will not impede curing.

2.1.10 Expansion Joint Filler

Expansion joint filler shall not contain holes and shall be Redwood, all heartwood; Western Red Cedar, all heartwood; or CCA pressure treated lumber with a minimum retention of 0.40 pcf. Expansion joint material shall be certified by the manufacturer, the grade, and the CCA retention, if applicable, shall be marked on each piece of wood before shipment.
2.1.11 Joint Sealer

Joint sealer shall be capable of being placed on the slopes shown at manufacturer recommended placing temperatures and in accordance with paragraph "JOINTS". Sealer shall comply with ASTM D3406 or BRSS-M-41: Class A, C, R or S. Preliminary acceptance of the sealant will be based on a certificate of compliance or manufacturer's literature which states compliance together with manufacturer's literature detailing the recommended application method and equipment. Final acceptance of the sealant will be based on a successful field demonstration.

PART 3 EXECUTION

3.1 LEVEE CROWN AND SLOPE

3.1.1 Levee Crown

The crown of the levee to be used by construction traffic shall be conditioned in advance of pavement operations to carry and withstand such traffic required by these specifications. The crown of the levee shall be graded to a reasonably smooth surface that slopes to drain. Throughout the period of pavement construction, the crown shall be maintained by shaping, addition of surfacing materials as specified in Section 32 15 00.00 12 SURFACING (GRANULAR), paragraph "MAINTENANCE", and compaction as may be necessary to avoid damage to the levee and permit passage of construction traffic. Wherever, by reason of rainwash, the Contractor's operations, or other causes, fill must be placed to bring the levee to design grade and cross section, embankment material shall be placed, and compacted in accordance with Section 31 24 00.00 12 EMBANKMENT, paragraph "Compacted Fill" and dressed in accordance with Section 31 24 00.00 12 EMBANKMENT, paragraph "Dressing."

3.1.2 Levee Slope

Preparation of the area to receive pavement shall commence as follows:

(1) Existing concrete slope pavement and riprap slope protection shall be removed and salvaged. The salvaged riprap or pavement shall be used as directed by the Government Representative.

(2) All vegetation and debris shall be removed from the floodside levee slope.

(3) The floodside levee slope shall be graded and/or degraded to a reasonably smooth, uniform surface to the slopes shown on the drawings, in such a manner as to maintain the maximum levee design section. Wavewash and rainwash gullies less than 6 inches in depth may be refilled by plowing and/or diskng the slope of the levee without adding any material. Gullies 6 inches or greater in depth shall be filled with embankment material compacted to a density at least equal to that of the adjoining undisturbed embankment and dressed in accordance with the requirements of Section 31 24 00.00 12 EMBANKMENT, paragraph "Dressing."

(4) After the levee slope has been prepared, but prior to excavation of the cutoff wall trench, the entire area above the original natural ground surface shall be compacted by not less than 5 passes over the entire surface by the treads of a crawler type tractor, or similar
equipment. A pass shall consist of complete coverage of the surface of a layer by the treads of the tractor or other compacting equipment approved by the Government Representative. Portions of the embankment, which the compacting equipment cannot reach for any reason, shall be compacted by an approved method to the density equal to that of the surrounding embankment. In the event the prepared slope is damaged or develops low areas in the course of compaction or during subsequent operations, embankment material shall be added, compacted and dressed. Dressing includes bringing the entire embankment to not less than the prescribed design cross section at all points in areas where embankment is to be placed on the riverside levee slope. Compaction shall be repeated to whatever extent is necessary to produce a smooth slope meeting the requirements of these specifications. After final compaction is completed, the area shall be dressed to a smooth surface suitable to receive the pavement.

3.2 TOE TRENCH

3.2.1 Excavation

The toe trench shall be smoothly excavated to the section and bottom elevation shown on the drawings. In the event that the toe trench is excavated to depths greater than those specified, the Contractor shall fill the excessive excavation by placing excavated embankment material in layers, 6 inches or less in thickness, and compacting each layer to the density of the adjacent undisturbed ground, up to the elevation specified for the bottom of the pavement. In lieu of filling the excessive excavation, the Contractor may extend the pavement, at full thickness, down to the bottom of the cut. However, if the Contractor elects to extend the pavement to elevations lower than those specified, no payment will be made for such extra pavement. The toe trench shall be kept thoroughly drained.

3.2.2 Stockpiling

Earth material from the toe trench excavation shall be placed to a uniform grade and section adjacent to the excavation in the batture area. Gaps at least 20 feet wide at intervals of no more than 200 feet shall be left in the stockpiled material to prevent ponding in the trench area.

3.2.3 Backfilling

Backfilling operations shall not commence before seven (7) calendar days, and must be completed within 14 calendar days after placing the bottom slab. The material excavated from the toe trench shall be used as backfill unless it is determined otherwise by the Government Representative. No backfill shall be placed in water. Backfilling shall be accomplished in accordance with Section 31 24 00.00 12 EMBANKMENT, paragraph "Uncompacted Fill" and shall not damage the pavement. Any pavement damaged during backfill operations shall, at the expense of the Contractor, be replaced or repaired as directed by the Government Representative. In the event that the backfill develops low areas, additional material shall be placed as may be necessary to produce a smooth backfill, without humps or hollows, to allow drainage away from the levee.

3.3 CUTOFF WALLS

Cutoff walls shall be constructed along the top of the pavement, and down
the slope of the levee from the top to the bottom of the pavement, in accordance with the details shown on the drawings. The cutoff wall trench shall be kept thoroughly drained.

3.4 JOINTS

Within 15 days after completion of the required curing period, all debris, dirt, laitance and curing compound shall be removed from all types of joints by sandblasting or another approved method. Immediately after cleaning, all joints shall be filled with sealant utilizing equipment and methods recommended by the sealant manufacturer. All joints shall be filled to within 1/8 inch plus or minus 1/16 inch below the pavement surface. The Contractor shall be careful not to over fill or under fill the joints.

3.4.1 Construction Joints

Construction joints shall be constructed where new pavement abuts existing new pavement in the direction parallel to the levee centerline. The surface of any existing new pavement against which new pavement is to be placed shall be chipped and wire brushed to the extent necessary to remove damaged and unsound concrete and provide a clean surface. A 1/2 inch wide by 1-3/8 inch deep recess as shown on the drawing shall be constructed for sealant. At all other locations throughout the limits of the job, construction joints will not be permitted unless approved by the Government Representative.

3.4.2 Dummy Joints

Dummy joints within the slabs shall be constructed a maximum distance of 10 feet from each other. These joints shall be 1/4 inch to 1/2 inch wide and 1-3/8 inches deep and shall extend from one end of the pavement to the other, in the direction perpendicular to the levee centerline.

3.4.3 Expansion Joints

Expansion joints shall be constructed perpendicular to the levee centerline at 80 foot maximum intervals, where new pavement abuts existing old pavement and at locations where the Contractor stops the pavement operation on any day. Expansion joint filler shall be one continuous piece the full width of each slab (ribbon). Expansion joints shall consist of 1/2 inch thick actual size, expansion joint filler topped with joint sealant, as shown on the drawings. Above the expansion joint filler, to the top surface of the pavement, the joint shall be formed with a 1/2 inch block of wood. This block shall remain in place for 24 hours or longer as determined by the Government Representative, if block removal operations cause breakage of the pavement.

3.5 FORMING

3.5.1 Form Construction

Forms shall be true to line and grade, mortar tight and sufficiently staked to prevent deformation under load in excess of 1/4 inch in 10 feet. All forms shall be so constructed that they can be removed without damaging the concrete.
3.5.2 Form Coating

Forms shall be coated with a form release agent, which shall be applied shortly before concrete is placed.

3.5.3 Form Removal

Forms shall not be removed for 24 hours after concrete placement, except when otherwise authorized by the Government Representative.

3.6 PREPARATION FOR PLACING

Concrete placement shall not begin until the entire levee, and cross section has been brought to the lines and grades shown, unless approved by the Government Representative. Construction joints shall be prepared and the surface shall be clean, damp and free of laitance. Formwork shall be complete. Snow, ice, water, debris and foreign matter shall have been removed. Earth foundations shall be compacted and dressed as specified in Section 31 24 00.00 12 EMBANKMENT. All equipment needed for curing and protection of concrete shall be on hand and in good operating condition. The ground shall be moistened (being careful not to pond water) immediately prior to concrete placement to prevent the soil from prematurely drying out the fresh concrete. The entire preparation shall be accepted by the Government prior to placing concrete.

3.7 PRODUCTION OF CONCRETE

3.7.1 General

The equipment used by the Contractor to produce and place concrete shall be capable of doing so at a rate that will prevent the occurrence of cold joints. The Government Representative shall have free access to the batching and mixing plant at all times. If ready mix concrete is used, the name and location of the batch plant shall be submitted for information.

3.7.2 Storage

Cementitious materials shall be stored in a manner to prevent contamination or the absorption of moisture. Aggregates shall be stored to prevent contamination or segregation. Aggregate stockpiles shall be drained to prevent ponding at the base of the stockpiles.

3.7.3 Batching Equipment

Batching equipment shall conform to the requirements of CPMB-01.9 or ASTM C 94; however, rating plates attached to batch plant equipment are not required. The batching controls shall be semi automatic with interlocks or automatic. The batching system shall be equipped with an accurate recorder or recorders which meet the requirement of CPMB-01.9. The weighing equipment shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall have facilities to measure and record moisture contents of the aggregates and adjust mix proportions to compensate for varying moisture contents. Admixtures shall not be combined with other admixtures prior to their introduction into water or sand.
3.7.4 Mixing

The mixing of concrete and its uniformity shall conform to the requirements of ASTM C94. The materials shall be free from ice, snow, and frozen lumps before entering the mixer. Truck mixers shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. A batch ticket, as specified in ASTM C94, shall be furnished to the Government Representative for every batch of concrete when delivered to the project.

3.8 CONVEYING

Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods that will prevent segregation or loss of ingredients. Concrete mixed in stationary mixers and transferred by non-agitating equipment shall be placed within 30 minutes after it has been mixed unless otherwise authorized. When a truck mixer or agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregate or water.

3.9 PLACING

3.9.1 General

Concrete placement shall not be permitted when in the opinion of the Government Representative, weather conditions prevent proper placement, finishing and curing. Placement of concrete shall commence with the bottom slab being placed first, progressing up the levee slope to the top slab unless another order of work is approved by the Government Representative. The placement shall be carried on at such a rate that the formation of cold joints will be prevented. Concrete shall be worked into the corners and angles of the forms without permitting the materials to segregate. Concrete shall be placed within 15 minutes after it has been discharged from a truck mixer. No waste water or concrete from equipment cleaning shall be disposed of in forms or on completed pavement. The Contractor shall submit to the Government Representative for approval a diagram showing each designated area to be used for cleaning equipment and trucks of concrete.

3.9.2 Placing Temperature

The ambient temperature of the space adjacent to the concrete placement and the concrete surface to receive the concrete placement during cold weather shall be above 40 degrees F. Concrete, when deposited in the forms during cold weather shall have a temperature of not less than 40 degrees F. When heating is necessary to keep the concrete temperature above 40 degrees F, it shall be regulated so that the concrete temperature does not exceed 75 degrees F. All concrete placed during warm weather shall be delivered to the forms at the coolest temperature that is practicable to produce under current conditions but not above 95 degrees F. Concrete shall contain a retarding admixture if its temperature exceeds 85 degrees F.

3.10 SURFACE FINISH

Finished surfaces shall be free from voids and sand streaks. Plastering over of such imperfections will not be permitted. No floating of surfaces
will be required. The surface shall be finished by screeding or any other approved method that will give a rough finish to the concrete. No troweling will be permitted.

3.11 PROTECTION

Immediately after placement, all concrete shall be protected from premature drying and freezing temperatures. All concrete shall be adequately protected from damage. Concrete shall be protected from the damaging effects of rain for 12 hours, and flowing water for 14 days. Concrete slope pavement damaged by rain or flowing water shall be removed by the Contractor at no cost to the Government. No repair of damaged slope paving will be allowed. The air and forms in contact with concrete shall be maintained at temperatures above 40 degrees F for at least the first 3 days and at temperatures above freezing for the remainder of the specified curing period. No fire or excessive heat shall be permitted near or in direct contact at any time.

3.12 CURING

All concrete shall be cured with curing compound for 7 days. Curing operations shall commence immediately after the finishing operations have been completed. The curing compound shall be applied when the concrete surface is still damp but not wet with free water. Curing compound shall not be applied during rainfall. The entire surface of the paving shall be sprayed uniformly with curing compound. Curing compound shall be applied under pressure by mechanical sprayers operating at a minimum pressure of 75 pounds per square inch, and at the rate recommended by the curing compound manufacturer but, in no case greater than 400 square feet per gallon. The spraying equipment shall be of the fully atomizing type equipped so that the compound can be stirred continuously by effective mechanical or other approved means. At the time of use, the compound shall be in a thoroughly mixed condition. Hand spraying of odd widths or shapes and on concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Failure to provide sufficient cover material of the type specified, shall be cause for immediate rejection of all concrete not properly cured.

3.13 FINAL DRESSING

The depression in the floodside slope between the top of pavement and the floodside edge of the crown shall be filled with embankment material compacted in accordance with Section 31 24 00.00 12 EMBANKMENT, paragraph "Compacted Fill." The levee embankment adjacent to the pavement shall be flush with the top of the pavement. All areas of the levee, including the crown, damaged by the Contractor's operations shall be smoothly and evenly dressed so that there are no abrupt humps and/or hollows. The embankment shall be brought to not less than the prescribed design cross section at all points. The entire finished surface shall be compacted as described in Section 31 24 00.00 12 EMBANKMENT, paragraph "Compacted Fill." No forms or other foreign material of any description shall be left in the levee. All depressions caused by the removal of forms and foreign matter shall be filled with embankment material and compacted to a density at least equal to that of the adjacent levee.

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PART 1   GENERAL

1.1 MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)**


ANSI/AGMA 6013 (2006A; R 2011) Standard for Industrial Enclosed Gear Drives

**AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)**


**AMERICAN WELDING SOCIETY (AWS)**

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel


**ASME INTERNATIONAL (ASME)**

ASME B30.10 (2009) Hooks

ASME B30.2 (2011) Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)

**ASTM INTERNATIONAL (ASTM)**


Magnetic Particle Examination of Steel Forgings

ASTM A668/A668M

ASTM A931

ASTM E543

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70
(2010) Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250

NEMA ICS 2
(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 3
(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC

NEMA ICS 6
(1993; R 2011) Enclosures

NEMA ICS 8
(2011) Crane and Hoist Controllers

NEMA MG 1
(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70
(2011; Errata 2 2012) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910
Occupational Safety and Health Standards

29 CFR 1910.147
Control of Hazardous Energy (Lock Out/Tag Out)

29 CFR 1910.179
Overhead and Gantry Cranes

29 CFR 1910.306
Specific Purpose Equipment and Installations

UNDERWRITERS LABORATORIES (UL)

UL 1004-1
UL 1449 (2006; Reprint Jul 2012) Surge Protective Devices

UL 489 (2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations

UL 943 (2006; Reprint Jun 2012) Ground-Fault Circuit-Interrupters

1.3 DEFINITIONS

a. Crane Bridge: That part of an overhead crane system consisting of girder(s), end trucks, end ties, walkway, and drive mechanism which carries the trolley(s) and travels along the runway rails parallel to the runway.

b. Crane Runway: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.

c. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.

d. Girder: The principal horizontal beam of the crane bridge. It is supported by the crane end trucks.

e. Live Load: A load which moves relative to the structure under consideration.

f. Pendant: A control for a hoist and/or a crane. The pendant hangs from the hoist or the crane by a cable at a height that is easy for the operator to reach.

g. Rated Load: For the purpose of this specification the rated load is defined as the maximum working load suspended under the load hook.

h. Standard Commercial Cataloged Product: A product which is currently being sold, or previously has been sold, in substantial quantities to the general public, industry or Government in the course of normal business operations. Models, samples, prototypes or experimental units do not meet this definition. The term "cataloged" as specified in this section is defined as "appearing" on the manufacturer's published product data sheets. These data sheets must have been published or copyrighted prior to the issue date of this solicitation and have a document identification number or bulletin number.

i. Top Running Crane: An electric overhead traveling crane that runs on rails on top of support girders.

j. Trolley Mounted Hoist: A combined unit consisting of a wheeled trolley that provides horizontal motion along the bridge girder, and a hoist supported by the trolley, that provides lifting and lowering of a freely suspended load.
1.4 REQUIREMENTS

The requirements for the crane runway system and rail supporting structures are specified in Section 05 12 00, STRUCTURAL STEEL, and must conform to AISC 325.

1.5 VERIFICATION OF DIMENSIONS

The Contractor is responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. Verify all dimensions of the building that relate to fabrication of the crane and notify the Government Representative of any discrepancy before finalizing the crane order.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
  Overhead electric crane; G

SD-03 Product Data
  Gear Reducers; G
  Hook; G
  Trolley; G
  Inverter Drives; G
  Control Parameter Settings; G
  Hoist; G
  Controls; G
  Electrification; G
  Motors; G
  Brakes; G
  Capacity Overload Protective Device; G
  Limit Switches; G

SD-05 Design Data
  Load and sizing calculations; G

SD-06 Test Reports
  Hook and hook nut magnetic-particle Tests;
Wire rope breaking strength
Post-erection inspection
Operational Tests; G
Hook Proof Test
Hook Tram Measurement
No-load Test
Load Tests; G
SD-07 Certificates
Overload Test Certificate
Certificate of the Coupling Alignment Verification Record
Brake Setting Record;
Certificate of Compliance with Listed Standards; G
SD-10 Operation and Maintenance Data
Overhead electric crane; G
Data Package 3; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, including weekly, monthly, semi-annual, and annual required maintenance items.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualification

Overhead electric crane system, including sub-system components manufactured by vendors, must be designed and manufactured by a company with a minimum of ten (10) years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents.

1.7.2 Pre-Delivery Inspections

Contractor is responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly and trolley as follows.

1.7.2.1 Inspection of Steel Castings

Visually inspect and test load-carrying steel castings using the magnetic-particle inspection method using ultrasonic testing. All load bearing components, couplings, shafts, and gears, in the hoist drive train must be rolled or forged steel, except brake drums which may be ductile iron. Methods of repairing the discontinuities is subject to review by
the Government Representative.

1.7.2.2 Inspection of Hook Assembly

Inspect hook and nut by a magnetic-particle type inspection per subpart titled Hook and Hook Nut Magnetic-Particle Tests and tested ultrasonically prior to delivery. Furnish documentation of hook inspection to the Government Representative prior to field operational testing. As part of the acceptance standard, linear indications greater than 1/16 inch are not allowed. Welding repairs of hook are not permitted. A hook showing linear indications, damage or deformation is not acceptable and must be replaced immediately.

1.7.2.3 Hook Proof Test

Proof test the load hook per ASME B30.10.

1.7.3 Certificates

Submit an Overload Test Certificate stating that the crane can be periodically load tested to 125 percent (plus 5 minus 0) of rated load.

Submit a Certificate of Compliance with Listed Standards.

Submit a Certificate of the Coupling Alignment Verification Record.

Submit a Certificate of the Brake Setting Record

1.7.4 Drawings: Overhead Electric Crane

Submit shop drawings showing the general arrangement of all components in plan, elevation, and end views; hook approaches on all four sides, clearances and principal dimensions, assemblies of hoist, trolley and bridge drives, motor nameplate data, overcurrent protective device ratings, and electrical schematic drawings. Include weights of components and maximum bridge wheel loads and spacing.

Shop drawing quality must be equivalent to the contract drawings accompanying this solicitation. Drawings must be reviewed, signed and sealed by a registered professional engineer.

Provide integral schedule of crane components on each drawing. Provide maximum wheel loads (without impact) and spacing imparted to the crane runway system track beams. Indicate the crane speeds along the runway, the trolley speeds along the bridge girder, and the hoist lifting speeds; all speeds indicated are speeds with hoist loaded with rated crane capacity load.

1.7.5 Design Data: Load and Sizing Calculations

Submit calculations reviewed, signed and sealed by a registered professional engineer verifying the sizing of the bridge girder, end trucks, travel drives, and overcurrent protection for motors, controllers, and branch circuits.

1.7.6 Welding Qualifications and Procedures

Welding must be in accordance with qualified procedures using AWS D14.1/D14.1M as modified. Written welding procedures must specify the
Contractor's standard dimensional tolerances for deviation from camber and sweep and not exceed those specified in AWS D14.1/D14.1M and CMAA 70. Welders and welding operators must be qualified in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M. Allowable stress values must comply with CMAA 70.

1.8 CRANE SAFETY

Comply with the mandatory and advisory safety requirements of ASME B30.10, and NFPA 70. Submit data on Capacity Overload Protective Device.

PART 2 PRODUCTS

2.1 TOP RUNNING CRANE SYSTEM

Provide top running overhead electric traveling (OET) crane conforming to CMAA 70, Class A Standby or Infrequent Service for indoor/outdoor service, ASME B30.2, with a vertical lift of 36 feet and as specified herein. The crane span must be 24 feet, and be designed to operate in an ambient temperature between 40 and 100 degrees Fahrenheit.

Provide a footwalk on the drive girder side, and idler girder side with crossovers on the end trucks to allow access to all maintainable features of the crane. The crane must be pendant and operate in the spaces and within the loading conditions indicated. The pendant controller must be mounted on a separate festooned cable system from the trolley power supply.

The crane must operate on 480-volts AC, 60 Hz, three phase power source. Maximum crane wheel loads (without impact) due to dead and live loads, with the trolley in any position, must not cause a more severe loading condition in the runway support structure than that produced by the design wheel loads and spacing indicated.

Submit Overhead electric crane, Data Package 3, including recommended maintenance items on a weekly, monthly, semi-annual, and annual basis.

2.1.1 Capacity

Provide a crane with a minimum rated capacity of 15 tons. Mark the rated capacity in both kilogram and pound units printed in different colors on both sides of the crane on the bridge girders. Capacity marks must be clearly visible to the operator at ground level.

2.1.2 Speeds

OET crane must have the following full load speeds (plus or minus 10 percent):

a. Hoist - rated speed of 20 feet per minute 11 feet per minute and 5.5 fpm plus inching control

b. Trolley - rated speed of 15 feet per minute

c. Bridge - rated speed of 10 feet per minute

For two speed motions, provide the low speeds at less than half of the specified rated speeds.
2.1.3 Hoist

Provide hoist conforming to ASME B30.2 and CMAA 70 Class C or better, double reeved, except as modified and supplemented in this section. Equip hoist with a spring set, electro-mechanically released brake plus a mechanical load brake.

2.1.4 Crane Safety


2.2 STRUCTURAL REQUIREMENTS

Structural requirements must be in accordance with CMAA 70, Section 3.

2.3 MECHANICAL EQUIPMENT

Cast iron and aluminum used to support components of the hoist power transmission train must be ductile.

All bearings, except those subject only to small rocker motion, must be anti friction type.

2.3.1 Drives

2.3.1.1 Bridge Drives

Bridge drives must be either the A-1 or A-4 drive arrangement as specified in CMAA 70.

Provide bridge drive consisting of a single electric motor mechanically connected through gear reduction and drive shafts to the drive wheels or separate drive motors at each end of bridge.

Acceleration and deceleration must meet the requirements specified in this section. Gears must conform to applicable AGMA standards. Provide oil tight fully enclosed gear reducers with pressure or splash type lubrication. Bridge-travel limit-switches shall be provided. Bridge and trolley travel limit switches – runway (track) limit switches shall be mounted to the crane bridge and trolley, respectively, adjacent to one runway rail to interrupt current to the bridge and trolley controls. Adjustable limit switch actuators shall be installed on both ends of those rails to actuate the limit switches and stop the crane bridge or trolley prior to contacting the runway bumpers. Submit product data on inverter drives and control parameter settings.

2.3.1.2 Trolley Drives

Provide trolley complete with a drive arrangement with a minimum of two wheels driven by an integral electric motor. Drive mechanism must run in totally enclosed oil bath. Limit switches are optional for drive mechanism. Acceleration and deceleration controls must meet requirements specified in this section.

2.3.2 Load Block and Hook Assembly

Construct the load block of steel. Provide an unpainted single barbed forged steel hook complying with ASTM A668/A668M. Fit hook with safety latches designed to preclude inadvertent displacement of slings from the...
hook saddle. Provide hook nut with a removable type set screw or other
similar fastener, installed in a plane parallel to the longitudinal axis
of the hook shank. Do not weld hook nut. Hook must be free to rotate
through 360 degrees when supporting the test load up to 131.25 percent of
the rated capacity. Provide only hooks which are designed and
commercially rated in accordance with CMAA and conforming to ASME B30.10,
and CMAA 70.

Each hook and hook nut must be capable of complete disassembly which
enables access to all surfaces of hook, including shank and hook nut for
inspection purposes. Make provisions for the hook nut, or other
hook-to-block fastener, to be keyed to hook shank by means of a set screw
or similar, easily removable, securing device.

2.3.2.1 Hook and Hook Nut Magnetic-Particle Tests

Magnetic-particle inspect the hook and nut over the entire area in
accordance with ASTM A275/A275M. Acceptance standard is no defects. A
defect is defined as a linear indication that is greater than 1/16 inch
long.

Inspect each hook, including shank and hook nut, over the entire surface
areas by magnetic particle inspection. If hook nut is not used, any
device that functions the same as the hook nut must be inspected by
magnetic particle inspection.

a. Procedure: Conduct magnetic particle inspection in accordance with
ASTM A275/A275M with the following restrictions: Do not use DC yokes
(including switchable AC/DC yokes used in the DC mode) or permanent
magnet yokes. Do not use automatic powder blowers or any other form
of forced air other than from a hand-held bulb for the application or
removal of dry magnetic particles. Remove arc strikes. Equipment
ammeters must have an accuracy of plus or minus 5 percent of full
scale (equipment ammeter accuracy other than that stated is acceptable
provided the MT procedure states that a magnetic field indicator is
used to establish and verify adequate field strength for all aspects
of the inspection.)

b. Acceptance Criteria: Defects found on the hook or hook nut will
result in rejection of defective items for use on furnished hoist.
For this inspection, a defect is defined as a linear or non-linear
indication for which the largest dimension is greater than 1/16 inch.
Weld repairs for defects on hook or hook nut will not be permitted.

c. Test Report: Submit a test report of the magnetic particle inspection
of each hook and hook nut provided to the Government Representative
for approval prior to final acceptance of hoist installation. Certify
test reports by the testing organization.

The performing organization must provide a written statement of
certification to ASTM E543, have the procedures used for testing of
the hook and hook nut reviewed and approved by an independent Level
III examiner, and submit the approved procedures and certification to
the Government Representative with the test report.

d. Weld Repair: Weld repairs for defects on hooks or hook nuts are not
acceptable.
2.3.3 Hoisting Ropes

Wire ropes must conform to ASTM A1023/A1023M and be tested as required by ASTM A931. Provide 6 by 37 class construction hoisting ropes, with improved or extra improved plow steel, as a minimum, and an independent wire rope core. Maximum hoisting rope fleet angles must be 4 degrees for drums and 4.75 degrees for sheaves. Hoisting rope end connections, other than drum connections, must be speltered sockets with forged steel terminals or swaged fittings installed in a fashion that provides 100 percent of the breaking strength of the wire rope. Provide proof of wire rope breaking strength. Wedge sockets or aluminum swages are not permitted on wire rope end connections.

Provide wire rope minimum safety factor of 5 to 1 based on the ratio of actual minimum wire rope breaking load to the calculated load on rope when hoist is assumed loaded to rated capacity. Submit certification from rope manufacturer verifying provided wire rope breaking strength, to the Government Representative and secure approval prior to final acceptance of hoist. No paint or coatings are allowed on the wire rope. Minimum length of the wire rope must enable the load hook to operate through its full hook lift range and still have a minimum of two full wraps of wire rope around the rope drum.

2.3.4 Sheaves

Provide steel sheaves. Minimum pitch diameters must be 18 times the rope diameter for running sheaves, and 12 times the rope diameter for equalizer sheaves. Sheave surfaces which contact wire rope are not to be painted.

2.3.5 Hoist Drum

Provide drum made of steel. Design drum so that not less than two dead wraps of hoisting rope remain on each anchorage when the hook is in its extreme low position. Drum grooving must be right and left hand beginning at the ends and grooving toward the center of the drum. Minimum drum groove depth, must be 0.375 times the rope diameter. Minimum drum groove pitch must be either 1.14 times the rope diameter, or the rope diameter plus 1/8 inch, whichever is smaller. Minimum drum pitch diameter must be 18 times the rope diameter. Do not paint, coat, or galvanize the surface of the drum which comes in contact with wire rope.

For wire rope drums installed directly onto the output shaft of the hoist speed reducer without an intermediate flexible coupling, the drum to shaft connection must be a barrel coupling.

2.3.6 Gearing

Provide gearing of the enclosed gear reducers type. Provide spur, helical, or herringbone type gears and pinions only, forged, cast or rolled steel. Open-type gearing is not acceptable, except for final drives. Gears and pinions must have adequate strength and durability for the crane service class and be manufactured to ANSI/AGMA 2001 Quality Class 6 or better precision per ANSI/AGMA 2011.

2.3.7 Gear Reducers

Gear reducers must be standard items of manufacturers regularly engaged in the design and manufacture of gear reducers for integral components of standard hoists or hoist/trolley units of manufacturers regularly engaged
in the design and manufacture of hoists or hoist/trolley units for Class A, B or C cranes. Gear reducers must be designed, manufactured and rated in accordance with ANSI/AGMA 6013 (for trolley drives only), as applicable. Except for final reduction, the gear reduction units must be fully enclosed in oil-tight housing. Gearing must be designed to AGMA standards and operate in an oil bath. Operation must be smooth and quiet.

2.3.8 Open Gearing

Provide all gears and pinions with adequate strength and durability for the crane service class and manufactured to ANSI/AGMA 2001 quality class 6 or better precision per ANSI/AGMA 2011. Open gears must be enclosed with safety guards provided with openings with covers for inspection and access for grease lubrication.

2.3.9 Wheels

Provide double flanged trolley and bridge travel wheels of rolled-to-shape wrought or forged steel. Rim toughen wheels to not less than 320 Brinell Hardness Number (BHN). Wheel sizing and flange-to-rail head clearances must be in accordance with CMAA 70 recommendations.

2.3.10 Bridge and Trolley Brakes

Provide bridge and trolley drives with electro-mechanical brakes capable of stopping the motion of the bridge or trolley within a distance in feet equal to 10 percent of the full load speed in feet per minute when traveling at full speed with a full load. Brakes must have an externally accessible means to manually defeat the brake.

2.3.11 Hoist Brakes

Equip hoist with both a spring set, electro-mechanically or thruster released shoe or disc brake, plus a mechanical load brake. The mechanical load brake and the electro-mechanical or thruster brake must each, independently, stop and hold 131.25 percent of rated capacity. The electro-mechanical or thruster brake must be adjustable to 50 percent of its rated capacity, and must have an externally accessible means of manual release.

2.3.12 Bumpers

Provide bumpers on the bridge and trolley per CMAA 70 guidelines.

2.3.13 End Trucks

Configure bridge and trolley trucks with a feature that limits load movement to 1" in the event of wheel or shaft failure.

2.4 ELECTRICAL COMPONENTS

2.4.1 Motors

Motors must meet all applicable requirements of NEMA MG 1 and UL 1004-1. Motor insulation must be Class H, but with a Class B temperature rise. Provide two speed AC squirrel cage induction type motors for the bridge drives. Provide two speed, AC squirrel cage induction type motor for the hoist. The trolley drive shall be a single speed squirrel cage induction type. Provide Class F motor insulation for motors with magnetic controls.
Provide motor overload protection utilizing a thermal sensitive device embedded in its windings.

2.4.2 Controls

A separate controller shall be provided for each motor; however, a duplex controller shall be used for two motor bridge drives. Overload protection shall be in conformance with the requirements of NEMA ICS 2. Contactors that are used for starting, stopping, and reversing shall be mechanically and electrically interlocked.

2.4.2.1 Magnetic Control Equipment

The primary and accelerating contactors and/or static devices shall be mounted on one or more panels and shall be enclosed in a cabinet or cabinets. The control circuits shall be wired to terminal blocks or studs complete and ready for making all external connections. Magnetic contactors for individual motor controls shall have a rating the equivalent of the motor controlled, but in no case shall a contactor less than NEMA Type 1 to be used.

2.4.2.2 Control Panels

Control cabinets shall be fabricated of solid sheet steel designed and constructed to conform to the requirements of NEMA ICS 6 Type 4. Thermostatically controlled heaters shall be provided in each cabinet. Control cabinet doors shall be hinged, equipped with gaskets, and shall be fitted with key-lock handles designed to latch the door at top, center and bottom. A single key shall open all locks.

2.4.2.3 Pendant Control Station

Design - The pendant control station shall be suspended from the crane by a strain chain or 6 mm (1/4 inch) (minimum) wire rope strain lead of corrosion resistant steel. The pendant station shall be attached to the underside of the crane bridge footwalk. The pendant control station enclosure shall be NEMA Type 4 in accordance with NEMA ICS 6. Pushbuttons shall be heavy duty, dust-and-oil type having distinctly felt operating positions. Pushbuttons shall be so constructed that they cannot become hung-up in the control case. Pendant shall include a separate set of pushbuttons for each motion and for POWER ON-POWER OFF. A blue pilot light to indicate that the main contactor is energized and a white pilot light to indicate that power is available on the load side of the crane disconnect switch shall also be provided. The POWER OFF pushbutton shall have a bright red mushroom head. Operating pushbuttons and pilot lights shall meet the heavy-duty requirements of NEMA ICS 2. Pushbuttons shall be as follows:

- Hoist - up
- Hoist - down
- Bridge - North
- Bridge - South
- Trolley - East
- Trolley - West
- POWER OFF
- POWER ON
2.4.3 Protection

Protection must not be less than that required by NEMA ICS 3, NEMA ICS 8, CMAA 70, NFPA 70, UL 1004-1, UL 1449, UL 489, UL 50, UL 943, 29 CFR 1910.147, 29 CFR 1910.179, 29 CFR 1910.306 and all applicable provisions of 29 CFR 1910. Provide enclosed type circuit breaker readily accessible to the crane operator for crane disconnect. Provide an On/Off button that removes power from the motors, brakes and control circuit on the operator's control pendant station or radio controller. Provide for lockout/tagout of all hazardous energy sources.

2.4.4 Limit Switches

Provide primary upper and lower geared limit switches. Geared limits must allow reversing direction to back out of the limit without resetting. Provide a backup mechanical hook block activated upper limit switch wired independent of the directional controllers and the primary upper limit switch that removes power from the hoist motor, hoist brake and hoist controls conforming to UL 1449. The backup limit must require hoist resetting prior to operation of the hoist in any direction. Provide a three position keyed switch on the pendant control with positions for bypass of the primary upper limit (to allow testing of the backup upper limit) and bypass of the backup upper limit in the lower direction only.

2.4.5 Pendant Pushbutton Station

Suspend the pendant pushbutton station from an independent festooned messenger track system, operating the length of the bridge. Locate the pendant pushbutton station 4 feet above the finished floor. Clearly mark all controls for identification of functions. Provide directional contactors with both mechanical and electrical interlocks.

2.4.6 Bridge and Runway Electrification

Provide festooned type or enclosed safety bar type bridge electrification. Provide enclosed safety bar type runway electrification. Power collectors must be a fully redundant dual shoe.

2.4.7 Overload Protection

Provide overload protection for bridge, runway, and hoist systems. Hoist overload protection must be adjustable between 80 and 150 percent of hoist capacity.

2.4.8 Warning Devices

Provide a warning horn that is operable from a push button at the pendant pushbutton station.

2.4.9 Floodlights

Provide evenly spaced floodlights along the bridge. Select floodlights to provide an illumination level of 40 lumens at three feet above the finished floor. All lights must be vibration resistant and designed to prevent any material from falling from the fixture. Switch the floodlights from the station.
2.4.10 Indicator Lights

Provide Indicator Lights mounted in an enclosure on the bottom of the bridge with lights sized and positioned to be visible from the ground. The lights must be the dual-lamp type. Provide a white light to indicate that power is available on the load side of the crane disconnect and a blue light to indicate that the main contactor is energized. Light voltage must be 115 VAC. Provide nameplates that are legible from ground level. The nameplates must read, in their respective order, "POWER AVAILABLE" and "CRANE ENERGIZED". The POWER AVAILABLE light must be supplied by a separate, fused transformer for its energization.

2.5 ENCLOSURES

Provide enclosures for control panels, controls, and brakes in accordance with NEMA 250 and NEMA ICS 6, Classification Type 1 indoor, general purpose.

Provide a non-resettable hour meter, connected across the main line contactor, readable from the exterior of the main control panel, to indicate the elapsed number of hours the crane is energized.

2.6 CRANE PAINTING

Paint exposed portions of the crane and girders in accordance with CMAA 70. Desired color is brilliant yellow.

Coat faying surfaces of bolted connections per AISC 325, but do not apply finish paint.

Paint the load block brilliant yellow with black diagonal striping, one inch wide diagonal black stripes located on 2 inch centers. Paint, coatings, or galvanizing on the following items or areas is not acceptable: hoist wire ropes, hooks, hook nuts, or areas on sheaves or rope drums in contact with the wire ropes.

Factory paint electrical and mechanical equipment in accordance with the manufacturer's best standard practice (for the specified environment), except that electrical equipment doors, which expose current-carrying electrical conductors when opened, must be orange.

2.7 IDENTIFICATION PLATES

Furnish and install identification plates. Provide non-corrosive metal identification plates with clearly legible permanent lettering giving the manufacturer's name, model number, serial number, capacity in both kilogram and pound units printed in different colors, and other essential information or identification.

2.7.1 Markings on Crane, Trolley, and Hook

Markings include: bridge motion direction arrows on both sides of the bridge; and trolley motion direction arrows on both sides of trolley. Markings must be visible from push button station and from the loading point, corresponding to the push button labeling on the pendant pushbutton station. Mark the hook rated capacity in pounds on both sides of the hoist load block.
2.8 RUNWAY SYSTEM AND CRANE RAIL

Provide structural steel and crane rail as specified in Section 05 12 00 STRUCTURAL STEEL, and is not within the scope of this section.

PART 3 EXECUTION

3.1 ERECTION AND INSTALLATION

Erect and install the crane, complete in accordance with the approved submittals and in condition to perform the operational and acceptance tests.

3.2 ERECTION SERVICES

The crane manufacturer must provide supervisory erection services.

3.3 FIELD QUALITY CONTROL

3.3.1 Post-Erection Inspection

After erection, the Contractor and the Government Representative, and the Activity Crane Certifying Official must jointly inspect the crane bridge and hoist systems and components to determine compliance with specifications and approved submittals. Notify the Government Representative 10 days before the inspection. Provide a report of the inspection indicating the crane is considered ready for operational tests.

3.3.2 Operational Tests

Check the clearance envelope of the entire crane prior to picking or traversing any load to ensure there are no obstructions. Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacture, installation, and workmanship. Rectify all deficiencies disclosed by testing and retest the system or component to prove the crane is operational. The Contractor must furnish test loads, operating personnel, instruments, and other apparatus necessary to conduct field tests on the crane.

3.3.3 Test Data

Record test data on appropriate test record forms suitable for retention for the life of the crane. Record operating and startup current measurements for electrical equipment (motors and coils) using appropriate instrumentation (i.e., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values; abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) must be justified or appropriate adjustments performed. In addition, note, investigate, and correct any high temperatures or abnormal operation of any equipment or machinery. Record hoist, trolley, and bridge speeds during each test cycle.

3.3.4 Hook Tram Measurement

Establish a throat dimension base measurement by installing two tram points and measuring the distance between these tram points (plus or minus 1/64 inch). Record this base dimension. Measure the distance between tram points before and after load test. An increase in the throat opening
from the base measurement is cause for rejection.

3.3.5 No-Load Test

Raise and lower the hook through the full range of normal travel at rated speed for three complete cycles. Raise and lower the hook, testing other speeds of the crane. Verify proper operation of hoist limit switches. Operate the bridge and trolley in each direction the full distance between end stops. Operate through the entire speed range and verify proper brake operation.

3.3.6 Load Tests

Perform the following tests, as specified, with test loads of 100 percent of rated load.

3.3.6.1 Hoist

Disconnect or adjust the overload limit device to allow the hoist to lift the test load. Proof test the overload limit device after it is reconnected.

a. Static Load Test (125 percent of rated load): Check entire structure, holding brake and hoisting components as follows: With the trolley in the center of the bridge span, raise the test load approximately one foot. Hold the load for 10 minutes. Rotate the load and hook 360 degrees to check bearing operation with no binding. Observe lowering that may occur which indicates a weakness in the structure or malfunction of hoisting components or brakes. Verify that maximum beam and girder deflections do not exceed CMAA 70 design limits.

b. Raise and lower and test load through the full lift range. Operate continuously for a minimum of 5 minutes. As a minimum, operate in each speed for each test load. In addition, the dynamic test of test load sequence number 2 (125 percent of rated load) must be repeated for 10 cycles at rated speed, in order to demonstrate proper operation and repeatability of all functions without component overheating or malfunction. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake operation. Do not stop hoist for more than 15 seconds prior to commencing the next cycle.

c. Hoist Load Brake (125 percent of rated load): Raise test load approximately 5 feet. With the hoist controller in the neutral position, release (by hand) the holding brake. Document the method used to release the holding brake. The load brake must hold the test load. Again with the holding brake in the released position start the test load down (first point) and return the controller to the "off" position as the test load lowers. The load brake must stop and hold the test load.

d. Hoist Loss of Power Test (125 percent of rated load): Raise the test load to approximately 8 feet. While slowly lowering the test load (first point), disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

3.3.6.2 Trolley

Operate the trolley the full distance of the bridge rails in each direction with a test load of 125 percent of rated load on the hook (one
cycle). Check proper functioning of all drive speed control points. Verify proper brake action.

3.3.6.3 Bridge

With a test load of 125 percent of rated load on the hook, operate the bridge for the full length of the runway in one direction with the trolley at the extreme end of the bridge, and in the opposite direction with the trolley at the opposite extreme end of the bridge (one cycle). Check proper functioning of all drive speed control points. Check for any binding of the bridge end trucks and verify proper brake action. Record deficiencies. Secure from testing if deficiencies are found.

3.3.6.4 Rated Travel Tests

Repeat travel tests for trolley and bridge with a test load of 100 percent of rated load. Repeat the test for 5 cycles at rated speed to demonstrate proper operation and repeatability of all functions without the overheating or malfunction of any components. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake action. Do not stop machinery for more than 15 seconds prior to commencing the next cycle.

3.3.6.5 Trolley Loss of Power Test

With a test load of 100 percent of rated load, raise the test load approximately midway between the trolley and any permanent obstruction on the operating floor. Starting at a safe distance from walls or other obstructions, attain a slow speed (first point) of trolley travel. While maintaining a safe distance from obstructions, disconnect the main power source at the wall mounted safety switch (disconnect) to simulate a power failure. Verify that the trolley stops and that the brake sets properly. Measure the distance required for the trolley to stop.

3.3.6.6 Bridge Loss of Power Test

With a test load of 100 percent of rated load, raise the test load approximately midway between the trolley and any permanent obstruction on the operating floor. Starting at a safe distance from walls or other obstructions, attain a slow speed (first point) of bridge travel. While maintaining a safe distance from obstructions, disconnect the main power source at the wall mounted safety switch (disconnect) to simulate a power failure. Verify that the bridge stops and that the brake sets properly. Measure the distance required for the bridge to stop.

-- End of Section --
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PART 1  GENERAL

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Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.3 (2011) Malleable Iron Threaded Fittings, Classes 150 and 300


ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)


Silicate Block and Pipe Thermal Insulation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)


MSS SP-80 (2008; Errata 2012) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6 (1993; R 2011) Enclosures

NEMA MG 1 (2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (2012; Errata 2011; Errata 2011) Flammable and Combustible Liquids Code

NFPA 37 (2010; TIA 10-1) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA 70 (2011; Errata 2 2012) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE ARP892 (1965; R 1994) DC Starter-Generator, Engine


SAE J537 (2011) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 1236 (2006; Reprint Jul 2011) Standard for Battery Chargers for Charging Engine-Starter Batteries
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

   Layout and Shop Drawings; G
   Installation; G

SD-03 Product Data

   Equipment and Performance; G
   Cooling System; G
   Dynamic Analysis of Engine, Pump, and Governor; G
   Manufacturer's Published Instructions; G
   Natural Gas Fueled Engine Pump Drive; G
   Welder Qualifications
   Installation; G

SD-06 Test Reports

   Engine

      A fully documented shop test report.

      The field test report, documenting all data for lubrication oil temperature and flow, cooling water temperature and flow, and compliance with specified performance criteria tested during the field tests.

SD-07 Certificates

   Pressure Vessels
   Regulatory Requirements;

SD-11 Closeout Submittals

   As-Built Drawings; G
   Operation and Maintenance Manual; G

1.4 WELDER QUALIFICATIONS

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Qualify procedures and welders in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1.

Notify the Government Representative 24 hr in advance of tests, and the tests shall be performed at the work site, if practical. The welder or welding operator shall apply the assigned symbol near each weld made as a permanent personal record. Submit a letter listing the welder-qualifying procedures for each welder, complete with all supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.
1.5 REGULATORY REQUIREMENTS

1.5.1 General

Design, fabrication, and installation of the equipment shall conform to the applicable national, state, and local codes. Submit documentation for conformance according to paragraph SUBMITTALS.

1.5.2 Layout and Shop Drawings

Submit layout and shop drawings including the following:

a. Base-mounted equipment, complete with base and all attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Complete starting system.

c. Complete fuel system.

d. Complete cooling system.

e. Complete intake and exhaust systems.

f. Layout of relays, breakers, switches, and instrumentation provided and applicable single line and wiring diagrams with a written description of the sequence of operation.

g. Lubrication system complete including piping, pump(s), strainers, filters, heat exchangers for lube oil and turbocharger cooling.

h. Location, type, and description of vibration isolation devices for all applications.

i. The safety system, together with a detailed description of its operation. Wiring schematics, safety devices with a listing of their normal ranges, alarm and shutdown valves (to include operation parameters such as pressures, temperatures, voltages, currents, and speeds) shall be included.

j. Layout of the engine control panel and alarm panel.

k. Mounting and support for each panel and major piece of electrical equipment.

l. Engine lifting points and rigging instructions.

m. Alignment information for the engine, gear box and pump specifying sequences, tolerances, and temperature change effects.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect material and equipment from weather, humidity, temperature variation, dirt, dust, and other contaminants during delivery and storage. Lifting, moving, and storage of the engine shall be in accordance with manufacturer's requirements.
1.7 PROJECT/SITE CONDITIONS

<table>
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<tr>
<th>Condition</th>
<th>Value</th>
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</thead>
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<tr>
<td>Maximum Air Temperature</td>
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</tr>
<tr>
<td>Minimum Air Temperature</td>
<td>25 degrees C F</td>
</tr>
<tr>
<td>Raw Water Temperature</td>
<td>Max. 80 degrees C F</td>
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<td></td>
<td>Min. 35 degrees C F</td>
</tr>
<tr>
<td>Installation Elevation</td>
<td>12.5 m ft above sea level</td>
</tr>
</tbody>
</table>

Submit the record of the survey of the existing installation site conditions and verification of site work details.

1.8 MAINTENANCE

1.8.1 Extra Materials

Furnish the following minimum spare parts when applicable to the type of engine proposed.

<table>
<thead>
<tr>
<th>UNITS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 EA</td>
<td>Complete engine cylinder head(s) and valve set, etc. (if applicable)</td>
</tr>
<tr>
<td>1 EA</td>
<td>Complete valve set(s) for one cylinder with springs, cages, etc.</td>
</tr>
<tr>
<td>1 EA</td>
<td>Cylinder liner(s) with all necessary water seal rings</td>
</tr>
<tr>
<td>1 EA</td>
<td>Complete piston(s) with rings and connecting rod assemblies</td>
</tr>
<tr>
<td>1 EA</td>
<td>Wrist pins with retaining rings and wrist pin bearing shells</td>
</tr>
<tr>
<td>1 EA</td>
<td>Complete set(s) of piston rings for one engine</td>
</tr>
<tr>
<td>1 EA</td>
<td>Complete set(s) of main bearing shell of each size and type for the crankshaft of each engine rating supplied</td>
</tr>
<tr>
<td>1 EA</td>
<td>Complete gaskets set for one engine</td>
</tr>
<tr>
<td>1 EA</td>
<td>Refills, with storage box, for all lubricating oil filters for each engine</td>
</tr>
<tr>
<td>1 EA</td>
<td>Spare lubricating oil circulating pump assembly</td>
</tr>
<tr>
<td>1 EA</td>
<td>Jacket water pump</td>
</tr>
<tr>
<td>1 EA</td>
<td>Pre-lube oil pump and motor assembly (if applicable)</td>
</tr>
<tr>
<td>1 EA</td>
<td>Pressure transducer(s)</td>
</tr>
</tbody>
</table>

1.8.2 Special Tools

Provide one complete set of special tools required for maintenance. Special tools are those that only the manufacturer provides for special purposes or to reach otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box.
PART 2   PRODUCTS

2.1   SYSTEM DESCRIPTION

2.1.1   General Requirements

Provide and install complete and totally functional, each engine with all necessary ancillary equipment including, but not limited to, air filtration, starting system, instrumentation, lubrication, fuel system, cooling system, and engine exhaust system. Each engine rating shall be in accordance with SAE J1995. The Natural Gas Fueled Engine Pump Drive shall be complete units with all components, accessories, and system interconnections coordinated, so that the complete assembly shall have the capabilities required, for proper operation with the pump specified under Section 22 10 00.00 10 VERTICAL PUMPS, AXIAL-FLOW and the speed reducer specified in Section 33 45 00.00 10 SPEED REDUCERS FOR STORM WATER PUMPS.

Submit written documentation that the products being supplied are appropriate for this engine pump drive, including past performance of the drive on certain types of service, i.e., marine generators, pump drives, locomotives, metal shredders, etc., with a minimum operation of 2,000 hr per year of service with a minimum of 2 years of qualifying service. The certification of the unit's speed, horsepower, and duty rating that forms the basis of the qualifying experience is required for acceptance and shall be within 30 percent of this drive's rating.

2.1.2   Performance Requirements

<table>
<thead>
<tr>
<th>Service Requirements</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Capacity</td>
<td>110 percent maximum (hp) required from the pump curves at priming and specified speed plus power required by the accessories</td>
</tr>
<tr>
<td>Overload Capacity</td>
<td>110 percent rated capacity for 2 hours in 24 consecutive hours</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>1,800 RPM</td>
</tr>
</tbody>
</table>

Characteristics of the pump load for the engine drive are described in the Specification Section 22 10 00.00 10.

Site Ambient Conditions: The site characteristics are as described in paragraph PROJECT/SITE CONDITIONS.

2.1.3   Arrangement

Each engine, as shown and specified, is to be used as the prime mover for the vertical pump. Connect the engine shaft to the reducer input shaft with a flexible coupling. Coordinate among the manufacturers of the natural gas fueled engine, gear reducer, and the pump manufacturer to ensure the compatibility of these components including, but not limited to, the proper fit of engine and reducer shafts, the interaction of major components, and control of safety and alarm signals. Natural gas shall be supplied to the fuel solenoid shutoff valve to be supplied on the engine. Use a cooling system to maintain engine and lubricating oil temperatures at the temperatures recommended by the manufacturer. Furnish a starting
Provide each engine with a completely independent lubrication and pre-lubrication system with an engine-driven primary pump.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Standard Products

Provide materials and equipment, comprising the engine drive system, which are the standard products of manufacturers regularly engaged in the production of natural gas fueled engine pump drives and that essentially duplicate products which have been used satisfactorily for at least two years prior to bid opening. An offer proposing an experimental engine, one having a lesser or greater number of cylinders than the offerers' standard production engines, or one without a demonstrated satisfactory service record as a full natural gas fueled engine operating not less than 1,200 hr a year at not less than 75 percent rated load, will be rejected. All products shall be new.

2.2.2 Equipment and Performance

Submit equipment and performance data certifying that the engine and cooling system function properly in the ambient temperature specified and provides the following design and performance data:

a. The maximum allowable inlet temperature of the coolant fluid.

b. The minimum allowable inlet temperature of the coolant fluid.

c. The maximum allowable temperature rise in the coolant fluid through the engine.

d. The magnitude of monitored values defining alarm or action set points, and the tolerance (plus and/or minus) at which the protective device activates the alarm or action.

e. The minimum allowable inlet fuel temperature and fuel supply pressure.

f. The maximum impact/dynamic load that will be transferred from the engine to the structure.

Manufacturer's standard catalog data including a description and depiction of each engine and all ancillary equipment in sufficient detail to demonstrate complete specification compliance. If standard catalog data does not contain sufficient detail to verify compliance, then submit supplementary support documentation to verify compliance. All data submitted shall be on the engine manufacturer's letterhead and signed by a representative or official of the manufacturer authorized to make technical representations of his company's products.

2.2.3 Nameplates

Provide each major component with the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. As a minimum, nameplates shall be provided for the following items:

a. Engines
b. Pumps and pump motors
c. Radiators
d. Heaters
e. Exhaust mufflers
f. Heat exchangers

2.2.4 Personnel Safety Devices

Insulate, fully enclose, guard, or fit with other types of safety devices all exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel. Install the safety devices so that proper operation of the equipment is not impaired.

2.3 MATERIALS

2.3.1 Filter Elements

Provide fuel-oil, lubricating-oil, and combustion-air filter elements which are the manufacturer's standard type and able to filter out particles down to a 25 to 40 micron size, unless otherwise noted.

2.3.2 Pipe (150 psi System and Under)

Pipe for sleeves, fuel/lube-oil, compressed air, coolant, exhaust, and miscellaneous uses shall comply with ASTM A53/A53M, or ASTM A106/A106M steel pipe. Pipe smaller than 2 inch shall be Schedule 80. Pipe 2 inch and larger shall be Schedule 40.

a. Flanges and flanged fittings: ASTM A181/A181M, Class 150, or ASME B16.5.

b. Pipe welding fittings: ASTM A234/A234M, Grade WPB or WPC, Class 150 or ASME B16.11, 3,000 lbs.


d. Valves: MSS SP-80, Class 150.

e. Gaskets: manufacturer's standard.

2.3.3 Temperature Gauges for Oil or Water Service

Manufacturer's standard flush-mounted, 4 inch minimum diameter dial size with standard operating point at 50 percent of the full gauge range. Gauge construction and materials shall be appropriate for the intended service.

2.3.4 Pipe Hangers

MSS SP-58 and MSS SP-69

2.3.5 Pressure Gauges

Manufacturer's standard flush mounted, 4 inch minimum dial diameter with standard operating point at 50 percent of the full gauge range. Gauge construction and materials shall be appropriate for the intended service.
2.4 NATURAL GAS FUELED ENGINE

a. The engine shall be a natural gas fueled, 2 or 4 cycle, spark ignition type, for stationary applications and shall operate on standard pipeline natural gas. The engine shall be naturally aspirated or turbocharged-aftercooled.

b. The engine rating shall be as specified in paragraph PERFORMANCE REQUIREMENTS. The engine shall be of the vertical in-line, vee, or opposed-piston type, with a solid cast block or individually cast cylinders. Opposed-piston engines shall have no less than four cylinders. Engines shall be current models of a type in regular production and shall be complete with all devices specified or normally furnished with the engine.

2.4.1 Fuel Consumption

Engine fuel consumption shall not exceed the following maximum limits based on the conditions listed below:

<table>
<thead>
<tr>
<th>SIZE RANGE NET kW</th>
<th>PERCENT OF RATED FULL LOAD</th>
<th>FUEL USAGE kJ/kWh btu/bhp-hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 - 299</td>
<td>75 - 100</td>
<td>12,340,700</td>
</tr>
<tr>
<td>300 - 999</td>
<td>75 - 100</td>
<td>11,325,000</td>
</tr>
<tr>
<td>1,000 - 2,500</td>
<td>75 - 100</td>
<td>11,325,000</td>
</tr>
</tbody>
</table>

Conditions:

a. Based on 118 octane natural gas with a heat value of 900 btu/ft³.

b. Sea level operation.

c. 77 degrees F ambient air temperature at 30 percent relative humidity.

d. 29.53 inch of mercury barometer pressure.

2.4.2 Crankcase Pressure Relief Valve

A pressure relief valve shall be provided in the crankcase. The crankcase shall be vented in accordance with the manufacturer's recommendations. Crankcase breathers using the venturi effect of the exhaust system will be allowed only when designed, installed, and provided directly from the engine manufacturer. Otherwise, the crankcase shall be vented to the outside and fitted with a goose neck to prevent rain entry.

2.5 FUEL SYSTEM

The fuel system for each engine shall conform to requirements of NFPA 30 and NFPA 37. The fuel system shall include the following items.

2.5.1 Fuel Pump

Each engine shall be provided with a fuel solenoid shutoff wired to a shutdown system and a fuel pressure regulator supplied by the engine.
manufacturer to control the fuel over air mixture to the engine. The fuel supply pressure available at the site is to be provided by the Utility Company. The engine fuel system design shall be adequate to power to 110 percent load at the site fuel supply pressure as stated above.

2.5.2 Filter

Each engine shall be provided with a fuel filter located upstream of the fuel solenoid shutoff to filter 100 percent of the incoming gas. The filter shall have inlet and outlet connections plainly marked. An indicating differential pressure gauge shall be provided across the filter. The filter shall be capable of filtering out particles down to 5 micron size.

2.5.3 Fuel Gas Compressor

Where the basic engine fuel system design requires fuel pressures above that available at the site, a fuel gas compressor is required. This fuel gas compressor shall be selected and certified by the engine manufacturer to comply with both these specifications and the requirements of the engine throughout its load range and up to 110 percent load. The fuel gas compressor shall be packaged on the same skid as the engine with a fully plumbed fuel system providing one point for fuel connection and junction boxes as required for electrical connections.

2.5.4 Fuel Supply

The natural gas fuel supply shall be provided by utility company.

2.6 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven pumps. A sump tank shall be furnished as required. The lube-oil pump shall draw oil from the oil pan or sump tank through a mesh intake strainer and force it through a lubricating oil cooler and a single or duplex full-flow strainer into the engine. The pump shall be protected by a relief valve to bypass the oil into sump. A portion of the oil from the sump shall be bypassed through a lubricating oil filter and back into the engine oil pan or sump. The lubricating oil temperature shall be regulated by means of an automatic temperature regulator which will control the amount of bypass oil around the cooler. The system shall be readily accessible for service such as draining or refilling. Each system shall permit the addition of oil and have oil-level indication with the set operating.

2.6.1 Pump Filters

One full-flow, duplex, 80 micron filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked. An indicating differential pressure gauge shall be provided across the filter.

2.6.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil temperature and pressure sensors. Temperature sensors shall provide signals for pre-high and high lube-oil indication and alarms. Pressure sensors shall be located downstream of the filters and provide signals for pre-low and low lube-oil
indication and alarms.

2.6.3 Lubricating Oil Strainer

A full-flow, oil strainer shall be furnished in-line, ahead of the engine. The strainer shall be as recommended by the engine manufacturer. A bottom drain plug shall allow easy removal of the sludge.

2.6.4 Pre-Lubrication Oil Pump

The pre-lubricating oil pump shall have a capacity and head rating as recommended by the engine manufacturer. The pump shall incorporate a built-in relief valve and be directly connected to an electric motor with the motor-pump assembly mounted on a common case iron or steel base. The pump shall be furnished complete and ready for operation with all controls inclusive. The pre-lubrication pump shall completely fill the engine oil lines and establish lubricating oil pressure prior to starting. The pump motor shall be in accordance with the requirements of paragraph MOTORS. The pre-lube pump shall operate utilizing the DC engine starting system.

2.7 COOLING SYSTEM

a. Each engine shall have its own cooling system. The system shall be of the closed type and operate automatically while the engine is running.

b. The cooling system shall have an engine-driven water pump, fin-tube radiator and an automatic temperature regulating valve. The maximum temperature rise of the coolant across each engine shall not exceed the engine manufacturer's recommendation as submitted in paragraph SUBMITTALS.

c. The engine cooling system shall be of the closed type arranged to prevent rust and minimize formation of scale deposits within the engine. The system shall circulate jacket-coolant through the engine at the temperature and flow rate recommended by the engine manufacturer. The coolant shall be an ethylene-glycol water mixture with a concentration sufficient for freeze protection at the minimum outdoor temperature specified. The maximum temperature rise of the coolant shall be no more than that recommended and submitted in paragraph SUBMITTALS.

2.7.1 Coolant Pumps

Engine-driven jacket water pumps shall be of the centrifugal type. Raw-water centrifugal circulating pumps shall be engine driven. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers. The pump shall be a bronze fitted, single stage type with removable seal rings and stuffing box and properly sized for the intended purpose.

2.7.2 Radiator

Each radiator shall be sized to limit the maximum allowable temperature rise on the coolant across the engine to that recommended and submitted in paragraph SUBMITTALS, for the maximum outdoor design temperature and site elevation. Radiator fabrication materials shall be corrosion resistant and suitable for service in the ambient application conditions. The radiator may be factory coated with corrosive resistant film provided that corrective measures are taken to restore the heat rejection capability of
the radiator to the initial design requirement via over-sizing or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Government Representative. Radiators shall be the pressure type incorporating a pressure valve, vacuum valve, and a radiator cap. Radiator caps shall provide for pressure relief prior to removal. Each radiator and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psig. Each radiator shall be protected with a strong grille or screen guard. Radiators shall have at least two tapped holes. One tapped hole in the radiator shall be equipped with a drain cock; the rest shall be plugged. The remote located radiator shall be provided with an electric motor-driven fan. The fan shall be wired to operate when the engine operates. The radiator shall be mounted to the same skid as the engine and shall have a fan driver by the engine.

2.7.3 Thermostatic Control Valve

A modulating type, thermostatic control valve shall be provided in the coolant system to maintain the engine coolant temperature in the range submitted in paragraph SUBMITTALS.

2.7.4 Ductwork

The ductwork shall be as specified by equipment manufacturer. A flexible connection shall be used to connect the engine radiator to the burner. Material for the connection shall be wire-reinforced fiber glass. The connection shall be airtight.

2.7.5 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high coolant temperature indication and alarms.

Each engine shall be equipped with coolant temperature systems for both the jacket water system and the intercooler system when the engine is turbocharged.

2.8 SPECIAL LIMITATIONS

2.8.1 Vibration Isolation

The maximum engine vibration in the horizontal, vertical, and axial directions shall be limited to 6 mils peak-peak RMS, with an overall velocity limit of 0.95 inch/sec RMS. The engine shall be provided with a vibration-isolation system in accordance with the manufacturer's standard practice. Vibration-isolation systems shall be designed and qualified (as an integral part of the base and mounting system).

2.9 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing as shown on the project plans. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. A combined filter silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper.
2.10 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Exhaust piping shall be supported to minimize vibration. Provisions shall be made for pipe thermal expansion. Where a V-type engine having more than one exhaust outlet is provided, a V-type connector, with necessary flexible sections and hardware, shall connect the engine exhaust outlets. The exhaust connectors shall incorporate engine-mating and silencer-mating flanges, eliminating the need for adapters. The muffler and exhaust piping together shall be capable of reducing the noise level at the exhaust discharge location to a point below the maximum sound levels specified in paragraph SOUND LIMITATIONS, at a distance of 25 ft from the end of the exhaust piping directly along the path of discharge for horizontal discharged exhaust; at 45 deg apart in all directions, for vertically discharged exhausts, with the engine operating at 100 percent of service load.

2.10.1 Flexible Sections and Expansion Joints

A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be multiple-ply stainless steel expansion bellows type with standard 1.5 and 3 inch allowable axial expansion. Elements in the flexible sections shall be capable of absorbing vibration from the engine and compensating for thermal expansion and contraction.

2.10.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be fabricated of welded steel and designed for outside vertical mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support of the muffler in the location and position indicated on the plans. The pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be fabricated from aluminized steel. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler. The muffler shall be supplied complete with any necessary soot boxes or inspection ports required for adequate operation and maintenance. The entire exhaust system shall be sized appropriately so that the operation of the engine is not affected by the exhaust system.

2.10.3 Exhaust Piping

Horizontal sections of the exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be made utilizing long radius fittings. Exhaust piping not covered in this paragraph shall be run in accordance with paragraph PIPING INSTALLATION. Exhaust piping, mufflers, and silencers shall be insulated with ASTM C533 calcium silicate insulation, minimum of 3 inch thickness or an appropriate thickness to limit the surface temperature to values below 175 degrees F. Insulation shall be secured with not less than 0.375 inch width Type 304 stainless steel bands spaced no farther apart than 8 inches on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.016 inch with a factory-applied polyethylene and kraft paper moisture barrier. The jacket shall be secured with not less than 1/2 inch wide stainless steel bands, spaced no farther apart than 8 inch on centers. Longitudinal and circumferential seams of the jacket shall be lapped not
less than 3 inch. Jackets on horizontal lines shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall overlap so that the lower edge of each jacket overlaps the upper edge of the jacket below. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing rain cover. When the exhaust pipe exits the building, the pipe should be isolated from the wall by means of thimbles in accordance with NFPA 37.

2.11 PYROMETER

A pyrometer and thermocouple with calibrated leads shall be provided to indicate the temperature in the combined exhaust. For a supercharged engine, additional points, thermocouples and leads shall be provided to show the temperature in the turbocharger exhaust gas outlet and combustion air discharge passages. The selector switch shall be double pole, with an off position, one set of points for each thermocouple, and a suitable indicating dial. The pyrometer, thermocouple, leads, and compensating devices shall be calibrated to show true exhaust temperature within ±1 percent above the highest temperature encountered at 110 percent load conditions.

2.12 EMISSIONS

The finished installation shall comply with Federal and local regulations and restrictions regarding the limits of emissions such as carbon monoxide (CO), hydrocarbon (HC), and nitros (NOx).

2.13 STARTING SYSTEM

Each natural gas engine shall be provided with a starting system. The system shall be electric and of sufficient capacity to start the engine at the minimum temperature specified. The system shall have a start-stop switch which provides functions including testing, reset, manual run/start, manual stop, and adjustable cranking and cooling down operation. The starting system shall be the manufacturer's standard equipment.

2.13.1 Electrical Starting System

An electrical starting system shall be provided to operate on a 24-V DC utilizing a negative circuit ground. An adjustable cranking device should be included to limit the engine cranking to a specified time limit. Starting motors shall be in accordance with SAE ARP892.

2.13.1.1 Battery

A starting battery system shall be provided and include the battery, battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering, and relaying. The battery shall be in accordance with SAE J537. Critical system components (rack, protection, etc.) shall be designed to withstand the seismic acceleration forces specified in subparagraph VIBRATION ISOLATION AND SEISMIC RESTRAINTS under paragraph SPECIAL LIMITATIONS. The battery shall be a lead-acid type, with sufficient capacity, at the minimum indoor temperature specified, to provide a minimum cranking cycle consisting of three cranking periods of up to 8 sec per period with 8-sec intervals between crank periods.
2.13.1.2 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided to automatically recharge the batteries. The charger shall be capable of providing both automatic float charging and equalizing charging of the battery installation. The charger shall be capable of recharging fully depleted batteries within 8 hr and providing a floating charge rate for maintaining the batteries in a fully charged condition. An ammeter and voltmeter shall be provided on the charger to indicate charging rate and voltage. The charger shall have alarm functions providing indications of low battery voltage, high battery voltage, and battery charger malfunction.

2.13.2 Starting Aids

2.13.2.1 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within ±10 deg of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized, condensation is controlled, and the system ensures dependable, cold weather starts. Power supply for the heaters will be 200 volts AC.

2.13.2.2 Lube Oil Heaters

A thermostatically controlled electric heater shall be mounted in the engine lube oil storage tank to automatically maintain the lube oil within ±10 deg of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized and the system ensures dependable cold weather starts. Heaters shall be selected so that heater skin temperatures do not exceed 300 degrees F and have maximum heat densities of 13 W/inch square. Power supply for the heaters will be 200 volts AC.

2.14 SAFETY SYSTEM

Devices, wiring, remote annunciator panels, alarm panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate appropriate safety actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgment and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be dealt with as an alarm on that system element. The remote annunciator panels and alarm panel shall be as specified in paragraph PANELS.

2.14.1 Audible Signal

The audible alarm signal shall sound at a frequency of 60 Hz at a volume of 75 dB at 10 ft. The sound shall be continuously activated upon alarm and silenced upon acknowledgment.

2.14.2 Visual Signal

The visual signal shall be a panel light. The light shall normally be off but activated to blinking upon alarm. The light shall change to continuously lit upon acknowledgment. If automatic shutdown occurs, the
display shall remain in an activated status to indicate the cause of failure and shall not be reset until the cause of alarm has been cleared and/or restored to the normal condition. Shutdown alarms shall be amber.

2.14.3 Alarms and Action Logic

2.14.3.1 Shutdown

Shutdown signals shall simultaneously activate the audible signal, activate the visual signal, and stop the engine.

2.14.3.2 Problem

Problem signals shall activate the visual signal.

2.14.4 Alarm Panel

The panel shall be fabricated and located as specified in paragraph PANELS, and shall contain the following functions:

FUNCTION OR INDICATION/CONTROL ACTION (AUXILIARY ACTION)

a. Red emergency stop (push button or switch)/shutdown engine.

b. Panel-mounted detonation sensing system with alarm and shutdown lights. The detonation system will sense individual cylinder detonation and individually adjust cylinder timing to avoid detonation. The system must be programmable by standard PC with software and operating manual supplied at no additional charge. The system installed must have the capability of up to 30 crankshaft degrees of total timing variation for each cylinder. Beyond a programmed limit, the system will act to shut down the engine.

c. Engine overspeed indication (overspeed indication point as recommended by the engine supplier)/shutdown engine.

d. High lube-oil temperature indication (temperature as submitted)/shutdown engine.

e. Low lube-oil pressure indication (pressure as submitted)/shutdown engine.

f. High coolant fluid outlet temperature indication (temperature as submitted)/shutdown engine.

g. Pre-low lube-oil pressure indication (110 percent of low lube-oil pressure).

h. Pre-high coolant fluid temperature indication (10 degrees F lower than high coolant-fluid outlet temp. alarm).

i. Pre-high lube oil temperature indication (10 degrees F) lower before problem.

j. Crankcase pressure switch (adjustable) to detect crankcase pressure increase associated with scoring of liner and possible short term catastrophic failure. Shutdown with setpoint as submitted. Setpoint of the crankcase pressure switch is to be adjusted during start-up to provide close tolerance protection without nuisance

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tripping.

k. Failure to start within the specified time indication).

l. Compressed air low-pressure indication (80 percent of working pressure).

m. Engine battery voltage-low.

n. Engine battery voltage-high.

o. Engine battery charger malfunction/problem.

2.14.5 Time-Delay on Alarms

For startup of the engine, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.15 GOVERNOR

Each engine shall be provided with a governor to control the rotational speed of the engine in response to changing load requirements. The governor shall be configured for safe manual adjustment of the speed during operation of the engine, without special tools.

2.15.1 Speed Regulating Governor

The engine governor shall maintain close speed regulation under all load conditions. The speed variation shall not exceed 6 percent of normal speed when full load is suddenly applied or removed. The design of the governor shall be such that the engine speed may be changed by governor adjustment during engine operation to any speed between 80 and 100 percent of the normal speed (corresponding to normal operating pump speeds) within 2 percent. The speed fluctuation at any load shall not exceed 2 percent. A raise/lower speed control shall be mounted on the engine instrument board. The engine fuel rack servomotor shall be suitable for operation from a 120-V AC source.

2.15.2 Emergency Overspeed Governor and Load Limit

An emergency governor with overspeed trip shall be provided on each engine to shutdown the unit should the speed exceed a predetermined RPM. The overspeed trip shall also provide an alarm signal for remote indication. The emergency governor shall be independent of the regulating governor. When the overspeed stop has been tripped, the shutdown mechanisms shall be such that the engine fuel and or air supply is prevented in the shortest time practicable from entering the engine cylinders. The trip mechanism may be part of the governor. The engine shall have an overload fuel limit set at 110 percent of the full load.

2.15.3 Governor Controls Location

The governor control shall be located at a point convenient to the location of the engine instrument board as shown on the plans.
2.16 ENGINE INSTRUMENT BOARD

The engine instrument board shall be as specified in paragraph PANELS, and shall contain the following items:

a. Coolant-fluid inlet temperature display
b. Lubricating-oil pressure indicator
c. Lubricating-oil inlet temperature display
d. Red emergency stop push-button
e. Run-time meter
f. Fuel(gas) meter display
g. Fuel-header-pressure display
f. Manifold vacuum display
g. Intake air temperature display
h. Tachometer display
i. Engine start-stop switch
j. Start-attempt indicator light
k. Lubricating-oil prelubricating pump start-stop switch
l. Alarm panel
m. Pyrometer display with selector switch
n. Ammeter for starting battery charger
o. Voltmeter for starting battery
p. Timer for setting the starting battery charger's equalize charging rate duration

2.17 PANELS

Each panel shall be of the type and kind necessary to provide specified functions. Panels shall be mounted as shown on the plans. Instruments shall be mounted flush or semiflush. Convenient access to the back of panels shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. All instruments and devices shall be vibration resistant.

2.17.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6. Locking mechanisms shall be keyed alike.
2.17.2 Electronic

Electronic indicating instruments shall be 100 percent solid state, state-of-the-art, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault, and status conditions to a set of relay contacts. Instrument accuracy shall be not less than 2 percent for unit mounted devices, and 1 percent for control room, panel mounted devices, throughout a temperature range of -4 to +150 degrees F. Data display shall utilize LED or back-lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 1/2 inch.

2.17.3 Parameter Display

Continuous indication of the tachometer, lubricating-oil pressure, and safety system parameters shall be provided. A momentary switch shall be specified for other panels.

2.18 BASE

The base shall be constructed of structural steel. The base shall be designed to rigidly support the engine, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base shall not permit skidding in any direction during installation and shall withstand and mitigate the effects of synchronous vibration of the engine and pump. The base shall be provided with suitable holes for anchor bolts.

2.19 MOTORS

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings and a maximum speed of 1,800 rpm. Motors shall have drip-proof frames; alternating current motors larger than 1/2 hp shall be of the squirrel-cage induction type for operation on 240 V, 60 Hz, three-phase AC power. Alternating current motors 373 W (1/2 hp) or smaller, shall be suitable for operation on 120 V, 60 Hz, single-phase, AC power. Direct current motors shall be suitable for operation on 24 V DC. Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.20 PAINTING

The engine and the accessory equipment including, but not limited to, panels, valves, piping, intake, and exhaust system components shall be cleaned, primed, and painted in accordance with the manufacturer's standard color and practice.

2.21 FACTORY INSPECTION AND TESTS

Prior to shipment, each engine shall be inspected and tested at the factory in the presence of the Government Representative or the authorized Government Representatives. The inspection shall cover all components including, but not limited to, governors, instrumentation panels, engine
starting system, intake and exhaust, lubrication system, cooling system, and fuel system. Inspection shall be completed and all necessary repairs made prior to testing. Unless otherwise directed by the Government Representative or the authorized Government Representative, the following factory tests shall be performed:

a. Simulated emergency or overspeed trip test.

b. Sustained operation test of 4 hr at rated full load.

c. Sustained operation test of 2 hr at 70 percent of rated full load.

d. Fuel consumption tests of not less than 1 hr each at 70 and 100 percent rated full load, respectively, using natural gas.

e. The engine shall be operated at no load to demonstrate that the governor and its associated engine manifold shutoff valve function properly.

f. Test data shall be taken at 30-min intervals and recorded on the manufacturer's natural gas fueled engine test data sheets. The test data sheets shall provide entries for all data required for the evaluation of natural gas fueled engine performance including noise and vibration. The test data shall be submitted for approval as required in paragraph SUBMITTALS. No engine shall be shipped until the test data has been approved by the Government Representative.

PART 3 EXECUTION

3.1 EXAMINATION

Before performing any work, visit the installation site and verify all details of the work. For new construction, review plans and elevations for adequacy and notify the Government Representative in writing of any discrepancies.

3.2 INSTALLATION

The installation of the equipment furnished under this section and related pumps and gear reducers under other sections shall be coordinated and installed in accordance with the approved installation procedures. Submit a copy of the manufacturer's installation and alignment procedures, including a detailed description of the manufacturer's recommended break-in procedure.

3.3 PIPING INSTALLATION

No section of pipe within a building shall exceed 20 ft in length between flanged fittings. Except where otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors and isolation valves. Bending of pipe shall be done with pipe benders, and no malformation shall be visible on bent pipe. Pipes extending through the roof shall be properly flashed. Piping shall be supported and permitted to expand and contract without damage to joints or hangers. Drain valves of 0.6 inch shall be installed at each low point in the piping.
3.3.1  Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced in accordance with ASME B31.1. Piping supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Government Representative.

3.3.1.1  Ceiling and Roof

Exhaust piping shall be supported with appropriate sized Type-41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized Type 1 clevis and threaded rods.

3.3.1.2  Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized Type 33 brackets with the appropriate ceiling and roof pipe supports.

3.3.2  Flanged Joints

Flanges shall be Class 125 type, drilled, and of the proper size and configuration to match the exhaust outlet of the engine. Flanged joints shall be gasketed and made to be square and tight.

3.3.3  Cleaning

After fabrication and before assembly, all piping interiors shall manually be wiped clean of all debris.

3.3.4  Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be a minimum of 0.6 inch larger than the outside diameter of the passing pipe or pipe covering, and where pipes pass through combustible materials, 1 inch larger than the outside diameter of the passing pipe or pipe covering.

3.4  ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Vibration isolation shall be provided for all conduit, cable trays, and raceways attached to the engine.

3.5  ONSITE INSPECTION AND TESTS

Perform the tests outlined in the subsequent subparagraphs after complete installation of each engine and its associated equipment and in accordance with the approved Dynamic Analysis of Engine, Pump, and Governor. Include supporting calculations with the Dynamic Analysis submittal.

Record data taken during runs at 30-min intervals and include all available pressure and temperature data which is monitored by the instrumentation furnished with the engine.
3.5.1 Instruments

Readings of panel gauges, meters, displays, instruments, etc. provided under the specification shall be verified during all test runs by test instruments of greater precision and accuracy than the operational equipment. Instruments used in the tests shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.2 Sequence

The tests shall follow the sequence outlined in subsequent paragraphs. Measurements shall be made and recorded of all parameters necessary to verify that each engine meets specified parameters. If the results of any of the test sequences are not satisfactory, adjustments or replacements shall be made and the test sequence repeated until satisfactory results are obtained.

3.5.2.1 Piping Test

a. Lube-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the out-flowing fluid is free of obvious sediment and emulsions.

b. The lube oil and coolant piping shall be hydrostatically pressure tested at 150 percent of the maximum anticipated working pressure, but in no case less than 150 psig for a period of 2 hr to demonstrate the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

Submit certificates of compliance for pressure vessels including official, signed statements from the fabricators of heat exchangers and expansion tanks associated with the engine cooling system certifying compliance with ASME BPVC SEC VIII D1.

3.5.2.2 Initial Inspection

a. Engine mounting bolts shall be visually inspected and checked for proper application and torque.

b. Correct functioning of the high and pre-high lubricating oil temperature circuit shall be demonstrated by removing the temperature-sensing elements from the engine and immersing the elements in a vessel containing controlled-temperature hot oil and recording the temperature at which the elements activate.

c. Correct functioning of the high and pre-high coolant-fluid outlet temperature circuit shall be demonstrated by removing the temperature-sensing elements of the circuit from the engine and immersing the elements in a vessel containing controlled-temperature hot coolant-fluid and recording the temperature at which the elements activate.

3.5.2.3 Electric Protective Device Tests

Protective devices shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Device ratings, settings, and other operational data shall be documented.
3.5.2.4 Safety Run Test

Should there be insufficient water available to operate the plant and to perform the engine tests, the Government Representative may delay the test for up to 9 months. The safety run test consists of the following sequence of tests:

a. The engine shall be started, the starting time recorded, and all of the engine manufacturer's recommended after-starting checks and inspections performed following a reasonable warm-up period.

b. The engine shall be operated for at least 2 hr at 75 percent rated speed.

c. Proper operation of all controls shall be verified.

d. Proper operation and set points of all gauges and instruments shall be verified. Setpoints shall be recorded.

e. Proper operation of all ancillary equipment shall be verified.

f. The manual emergency stop switch shall be activated and the time to stop the engine recorded.

g. The engine shall be started, the starting time recorded, the engine manufacturer's after-starting checks and inspections performed and recorded, and the engine operated for at least 15 min at 75 percent of rated speed.

h. The governor shall be manually adjusted to increase engine speed past the overspeed limit. The engine RPM at shutdown shall be recorded.

i. The time-delay low-lube oil pressure alarm bypass shall be temporarily removed from the engine safety circuits and an attempt made to start the engine. The results shall be recorded.

j. A manifold shall be attached to the engine oil system containing a shutoff valve in series with a connection for the engine's oil pressure sensor, followed by an oil pressure gauge, ending in a bleed valve. The oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be placed in the open position and the bleed valve closed.

k. The engine shall be started, the starting time recorded, the engine manufacturer's after-starting checks and inspections performed and recorded and the engine operated for at least 15 min at 75 percent of rated speed.

l. The manifold shutoff valve shall be closed. The pressure in the manifold shall be slowly bled off through the bleed valve while observing the pressure gauge. The pressure at which the engine shuts down shall be recorded. The oil spillage from the bleed valve shall be captured in a container. The oil system shall be refilled, the manifold removed, and the engine's oil pressure sensor reinstalled on the engine following the test.

m. The engine shall be started, the starting time recorded, the engine
manufacturer's after-starting checks and inspections performed and recorded and the engine operated for at least 15 min at 100 percent of rated speed. The maximum sound level in each frequency band at a distance of 75 ft from the end of the exhaust piping directly along the path of discharge for horizontally discharged exhausts shall be recorded. The maximum sound level in each frequency band at a distance of 35 ft from the silencer at 45 deg apart in all directions around the unit shall be recorded.

3.5.2.5 Final Inspection

a. The lube-oil filter shall be removed and the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, and other indications of engine distress. Any corrective actions shall be verified for effectiveness by running the engine for 8 hr at full rated speed, then re-examining the oil and filter.

b. The engine shall be inspected and all engine mounting bolts checked for tightness and visible damage.

3.6 MANUFACTURER'S FIELD SERVICE

3.6.1 Onsite Training

Conduct training courses for the plant operating staff as designated by the Government Representative. The training period shall consist of a total of 8 hr of normal working time and shall commence after the system is functionally completed, but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements addressed in the operations and maintenance manuals. Additionally, the course shall include demonstrations and instruction in all routine maintenance operations including oil change, oil filter change, air filter change, etc. Submit Two DVD copies of the entire training session.

Submit a letter giving the proposed date for conducting the onsite training course, the agenda of instruction, a description of the video taping service to be provided, and the kind and quality of the tape or DVD.

3.6.2 Field Engineer

The manufacturer or Contractor shall furnish a qualified engineer to supervise the complete installation of the engine, assist in performance of the onsite tests, and instruct personnel regarding operational and maintenance features of the equipment. Submit certification that the field engineer is qualified to perform the functions.

3.7 FIELD PAINTING

Field painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 MANUFACTURER'S PUBLISHED INSTRUCTIONS

Post instructions, including wiring and control diagrams showing the key mechanical and electrical control elements and a complete layout of the entire system. The instruction set shall be weatherproof, laminated in plastic, framed, and posted at a location as directed.
3.9 ACCEPTANCE

Final acceptance of the engine will not be made until the Contractor has successfully completed all tests, corrected all defects in installation material, and/or installation procedures, and all deficiencies identified in on-site testing or routine operation have been corrected.

3.10 CLOSEOUT ACTIVITIES

3.10.1 As-Built Drawings

Submit As-Built Drawings accurately depicting the as-built configuration of the supplied, installed, and accepted natural gas fueled engine pump drive.

3.10.2 Operation and Maintenance Manual

Also submit an Operation and Maintenance Manual for the natural gas fueled engine detailing start-up and operating procedures, lubrication instructions, installation and alignment procedures, routine maintenance requirements and procedures, complete detailed procedures for disassembly and reassembly of the engine, parts list for all parts detailed, assembly plans of the engine showing all parts, suppliers for all parts, settings and adjustment for protective devices, and a list of all tools, handling devices, and spare parts furnished.

-- End of Section --
PART 1 GENERAL

1.1 SYSTEM REQUIREMENTS
1.2 MEASUREMENT AND PAYMENT
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PART 2 PRODUCTS

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PART 3 EXECUTION

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3.2 INSTALLATION
3.3 FIELD TESTS AND INSPECTIONS

-- End of Section Table of Contents --
PART 1   GENERAL

1.1  SYSTEM REQUIREMENTS

The flow measuring equipment shall be the ultrasonic meter type. The design shall permit ease of installation and shall not have any features hazardous to personnel or detrimental to the equipment. Provision shall be made to align and adequately lubricate moving parts. Interior parts shall be easily accessible for adjustment, repair, and replacement.

1.2  MEASUREMENT AND PAYMENT

Refer to Section 01 22 00.00 10 MEASUREMENT AND PAYMENT.

1.3  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441 (2009; Rev D) Paint, Epoxy-Polyamide, General Specification for

1.4  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
   Flow measuring equipment components;  G
   Read-out device

SD-06 Test Reports
   Flow measuring equipment calibration;  G
   Open channel test
   Dimensional inspection report

SD-08 Manufacturer's Instructions
   Flow measuring equipment components
   Submit manufacturer's written recommendation for installation
1.5 QUALITY ASSURANCE

1.5.1 Requirements

Perform calibration and submit test report for flume in variable head meter for open channel. Submit dimensional inspection report and flow versus differential head curve for variable head meters for closed channel; accuracy shall be plus or minus 1.0 percent over a 10 to 1 flow range. Submit as required in paragraph entitled "Field Tests and Inspections."

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.

2.1.1 Ultrasonic Meter

Provide an ultrasonic meter where indicated. The meter shall have a velocity range of 0 to 20 feet per second. The flow meter shall consist of the primary element employing a single pair of electro-acoustic transducers mounted diagonally in a flow tube, and in direct contact with the liquid flow to be measured. The transmitter shall contain all necessary circuitry enclosed in NEMA 4 outdoor housing suitable for wall mounting and connected to the transducers by 100 feet of cable. It shall produce an accurate 4 to 20 mA dc signal linear with flow rate. It shall provide linearity of plus or minus 0.5 percent and repeatability of 0.1 percent under simulated flow. Long term drift of the pulse rate output shall be less than 0.1 percent. It shall operate with 115 or 230 volt plus or minus 10 percent, 50 or 60 Hz electrical power. The unit shall function over an ambient temperature range of 30 degrees F to 100 degrees F. The flow rate indicator shall be integrally mounted in the transmitter housing. Graduate 6 inch scale length in gpm.

2.2 READ-OUT DEVICE

Provide the meter with the following read-out device which shall read from 10 CFS TO 1,000 CFS.

2.2.1 Local Read-Out and Remote Transmission

Provide a recording transmitter and an integrator for local read-out and transmission of flow data to remote read-out. The scale graduation shall be uniform. The read-out shall be visible through a shatterproof clear window. The read-out and transmission mechanism shall not be affected by the intended end use of environment. The transmission shall be impulse duration type or milliamperes dc analog signal type to the remote read-out. Actuate all transmission by the output motion or the ac voltage signal of the meter. Power required shall come from the meter. When impulse duration type transmission is used, the system shall have a 15 second maximum cycle actuating a cam-operated contact. The contact shall be of the totally-enclosed type. The unit shall be non-corrosive and weatherproof or provided with a separate weatherproof housing with a sealed door for access to the mechanism, and designed to prevent the accumulation of moisture or fog inside the case. Provide a suitable
mounting.

2.2.1.1 Indicator

Shall be a minimum of 6 inches long.

2.2.1.2 Recorder

Shall be a minimum of 10 inches in diameter and shall rotate once daily. The chart drive shall be driven by a synchronous motor.

2.2.1.3 Integrator

Shall read the total flow in the units specified using only a whole power of 10 multiplier.

2.3 ELECTRICAL REQUIREMENTS

Unless indicated or specified otherwise, the electrical components of the meters, such as chart drives and electrical disconnecting (isolating) means, are included under this section. Provide wiring for signal circuit as specified by the equipment manufacturer. The interconnecting conduit and wire (except when otherwise specified herein, or when included in factory-assembled equipment) and the electrical connection of the meters to the electrical power circuit are specified in Division 16.

2.4 SPARE PARTS

Provide all standard recommended spare parts as specified in the manufacturer's instruction manuals for each component in the system.

PART 3 EXECUTION

3.1 MATERIALS PROTECTION

The entire tube, except the throat section shall receive a series of coats of paint conforming to MIL-DTL-24441. Apply the paint in the following order: one coat of Formula 150, one coat of Formula 151, one coat of Formula 156, and one coat of Formula 152. The final total dry-film thickness shall be not less than 10 mils. Furnish all other items in accordance with the manufacturer's standard practice suitable for end use environment.

3.2 INSTALLATION

Furnish the services of an engineer representative of the manufacturer of the flow measuring equipment for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative also shall be available for not less than 2 days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period. Install all flow measuring equipment in accordance with the recommendations of the manufacturer.

3.3 FIELD TESTS AND INSPECTIONS

Test and calibrate in place the flow measuring equipment to demonstrate that it meets the accuracy requirements for the full range of flows specified herein. Provide all labor, equipment, and incidentals required
for the tests, including electric power and water required for tests. The Government Representative will witness all field tests and conduct all field inspections. The Contractor shall give the Government Representative ample notice of the dates and times scheduled for tests. Rectify any deficiencies found and retest work affected by such deficiencies at the Contractor's expense. Record data from each field test shall be recorded and documented in a formal field test report.

-- End of Section --