SP-230087
(New)

SPECIAL PROVISIONS
FOR
STORM WATER PUMP STATION

Dallas County
NHSN-169-4(67)--2R-25

Effective Date
December 19, 2023

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

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SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Supervision and Superintendent:

1. The Contractor or competent Superintendent must be on the Project when construction activities are taking place. The Superintendent shall supervise, direct, and control the Contractor's operations, personnel, work and the Subcontractor's operations. The Contractor shall give the Engineer written notification of the name of the Superintendent. The Superintendent shall be employed by the General Contractor and shall be assigned to the project full-time. The Superintendent shall be incidental to mobilization. A copy of the contract documents shall be available on the project site at all times.
2. Contractor shall maintain a qualified and responsible person available 24 hours per day, 7 days per week to respond to emergencies which may occur after hours. Contractor shall provide to Engineer the phone number and/or paging service of this individual.
3. Incompetent or incorrigible employees shall be dismissed from Work by Contractor or its representative when requested by Engineer, and such persons shall not again be permitted to return to Work without written consent of Engineer.

1.02 CONTRACTING AUTHORITY OCCUPANCY

A. The Contracting Authority shall have the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding the time for completing the entire work or such portions as may not have expired; but such taking, possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents.
   1. If such prior use increases the cost of, or delays the Work, the Contractor shall be entitled to such extra compensation or extension of time, or both, as the Engineer may determine.

B. Contracting Authority intends to continue to occupy adjacent portions of the existing building during the entire construction period.
   1. Treatment plant must be maintained in operation throughout the entire construction period, with planned and scheduled shutdowns for connections, cut-ins, changeovers, etc.

C. Cooperate with Contracting Authority to minimize conflict and to facilitate Contracting Authority's operations.

D. Schedule the Work to accommodate Contracting Authority occupancy and operations.

E. Continuity of treatment system operation.
   1. Conduct work in a manner that avoids interruption of effective treatment system operation.
   2. Prevent the bypass of untreated wastewaters to surface water or drainage ways. Accidental bypasses caused by Contractor’s work activity will entitle Contracting Authority to:
      a. Employ others to stop bypassing without giving notice to Contractor.
      b. Recover from the Contractor all costs incurred by the Contracting Authority as a result of the bypass, including labor, materials, services, legal fees, regulatory penalties, and other related expenses.
   3. Submit with the Construction Schedule a detailed outage plan and schedule for each system component. Indicate how effective wastewater system operation will be maintained.

1.03 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on plans.

B. Limit use of site and premises to allow:
   1. Work by Others.
   2. Work by Contracting Authority.

3. Use of site and premises by the public.

C. All City properties are tobacco free, and policy will be enforced.

D. Provide access to and from site as required by law and by Contracting Authority.

E. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.

1.04 LAYOUT OF THE WORK

A. The Contracting Authority shall provide information to the Contractor regarding bench marks for the project. The Contractor shall be responsible for all detailed construction staking.

1.05 WORK SEQUENCE

A. Construct Work in stages to accommodate Contracting Authority's occupancy and operational requirements during the construction period. Coordinate construction schedule and operations with Contracting Authority.

B. All portions of work under the proposed Contract Documents shall be completed and ready for operation on or before the date set forth in the Notice of Hearing and Letting. Provisions for liquidated damages are set forth in the Contract.

C. The Contractor shall schedule Work so that interruption of existing utilities, including but not limited to: electric, telephone, communication, cable, gas, water, and sewer service will be at a minimum. When it is necessary to interrupt services, the Contractor shall notify the Contracting Authority's representative, Engineer, and appropriate utility companies 24 hours in advance of the interruption.

D. Plan the construction work and carry out with a minimum of interference with the operation of the existing facilities. Prior to starting the construction, confer with the Engineer and Contracting Authority's representative and develop a detailed, approved construction schedule which will permit the facilities to function as normally as practical during the construction period. It will be necessary to do certain parts of the construction work outside normal working hours and on Sundays in order to avoid undesirable conditions, and it shall be the obligation of the Contractor to do this work at such times at no additional cost to the Contracting Authority. Do not make connections between existing piping and new piping until necessary inspection and tests have been completed on the new work and it is found to conform in all respects to the requirements of the drawings and specifications.

E. Special notes detailing critical portions of the work involving removal, replacement, tie-in, changeover, etc. have been included in the drawings and the Work Sequence of this Section. These notes describe the work, timing, scheduling, and coordination with the Contracting Authority and Engineer necessary to complete the work. The detailed construction schedule shall be developed by the Contractor with consideration of these details and the overall progress of the work. The Engineer and Contracting Authority shall have full authority to review this schedule in order to protect the operation of the existing facilities during construction.

1.06 PERMITS, FEES AND NOTICES

A. The Contractor shall secure and pay for all permits and governmental fees, licenses and inspections for the proper execution and completion of the Work which are customarily secured after execution of the Contract and which were legally required at the time bids were received. City building permits and inspections are required, but the permit fees will be exempted.

1.07 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 Contracting Authority of adjacent property and of Underground Facilities and other utility Contracting Authority when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property 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.

D. 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 Contracting Authority and Contractor that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

END OF SECTION 01 1000

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals for Review, Information, and Project Closeout.

B. Number of Copies of Submittals.

C. Submittal Procedures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.

B. Submit for review according to the procedures and purposes described herein.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. Required Submittal Quality
1. Organization
   a. Cover Labeling
      1) Supplier name, address, and telephone number.
      2) Supplier's designated Project Number.
      3) Engineer's designated Project Name, Job Number, and Location.
      4) Engineer's firm name and location
      5) General contractors name and location
      6) Specification Section(s) applicable to submittal contents.
   b. Contents
      1) Cover sheet (same as Exterior Cover requirements) with at least a 4 inch by 4 inch blank space for Engineers Review Stamp.
      2) Table of Contents for all major equipment/devices/components/descriptions specified.
      3) Notification of all exceptions taken to the specifications.
      4) Order of Contents -- must be the same as order described in the applicable specification sections.
      5) Tabs separating each major equipment division.
2. Identification of Pertinent Information
   a. Provide Bill of Materials to indicate (at minimum) series, model number, and manufacturer.
   b. On catalog cut sheets:
      1) Identify series and complete model number proposed.
      2) Identify information pertinent to proposed model and conformance to specifications by arrow, underline, circular enclosure.
      3) Minimize non-specific information that does not indicate conformance or cross out non-pertinent information.
   c. On performance data/curves etc. clearly identify pertinent information (or cross out non-pertinent) data.
   d. On all documentation provided, illustrate exceptions to the contract documents.
3. Legible Quality
   a. Font size no less than 10; minimum character height no less than 1/16 inch.

b. No faxes accepted.
c. No copies of catalog cuts accepted where information is skewed off page or non-linear.
d. Basic information to be all typewritten; only identification of pertinent information may be hand written.

3.02 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
1. Design data.
2. Certificates.
3. Test reports.
4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Engineer's knowledge as contract administrator or for Contracting Authority.

3.03 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Contracting Authority's benefit during and after project completion.

3.04 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Documents for Information: Submit one copy.

C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed.

3.05 SUBMITTAL PROCEDURES

A. General Requirements:

B. Transmit each submittal electronically with a copy of approved submittal form.

C. Transmit each submittal with Contractor's standard submittal form.

D. Submittal number shall be in reference to Engineer's specification section. If there are multiple submittals to a singular specification section add a hyphen followed by a number. Re-submittals to have original number with an alphabetic suffix.
1. Examples:
a. Two submittals (from same specification section) for Project Review: 16 4250-1 & 16 4250-2; second submittal (after initial review was rejected): 16 4250-2-A.

E. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

F. Apply Contractor's standard certification stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and contract documents. Submittals without this certification will be returned without review.

G. Electronic Submittal Procedure
    1. Summary:
        a. Shop drawing and product data submittals shall be transmitted to Engineer in electronic (PDF) format via Doc Express.

H. Schedule submittals to expedite the Project, and deliver. Coordinate submission of related items.

I. Coordinate submittals with other submittals, related activities, sequential activities and overall performance of the Work.

J. Revise and submit submittals as required, identify all changes made since previous submittal.

K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.

L. Clearly identify on the transmittal sheet if the submittal represents “Or Equal” items or substitute items. If the submittal is a substitute, the substitution must result in a decrease in overall cost or result in saving construction time.

M. Contractor to investigate and evaluate for items with long lead times or critical path to execution of the contract, and to coordinate at least these items' submittal groupings with the Engineer. The Engineer accepts no burden for project delays where additional submittal cycles are required to ascertain conformance and intent to the contract documents.

N. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, give written notice thereof at least 7 calendar days prior to release for manufacture.

O. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith and make no further changes therein except upon written instructions from the Engineer.

3.06 ENGINEER'S REVIEW RESPONSIBILITIES, PROCEDURES AND DEFINITIONS

A. General
    1. Review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
        a. As permitting any departure from the Contract requirements;
        b. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
        c. As approving departures from details furnished by the Engineer, except as otherwise provided herein;
        d. As approving substitutions to specified products or manufacturers.
    2. The Engineer does not review for verification of quantities, weights, dimensions, or means and methods.
    3. Partial review status will not be given to a submittal. Entire submittal shall be either acceptable or the entire submittal must be resubmitted with corrections as clarified by status definitions below.
    4. Submittals will be reviewed in order received unless Contractor requests a revised order of review, in writing. All submittals shall be submitted sufficiently in advance of construction requirements to provide no less than 15 calendar days for review from the time the Engineer receives them. No less than 30 calendar days will be required for major equipment that requires review by more than one engineering discipline.

B. All submittals that have been reviewed by Engineer will have Engineer's Review Stamp affixed, initialed and dated, indicating Engineer's review action. No submittals shall be used for construction unless they bear the initialed Engineer's Review Stamp. Possible review actions by Engineer are:
    1. NO EXCEPTIONS NOTED. Engineer's review did not detect deviations from conformance and intent of the Contract Documents.

2. EXCEPTIONS NOTED. Engineer's review did not detect major deviations from conformance and intent of the contract documents; minor discrepancies and/or deficiencies are noted. Corrected copies are not required; however, the item(s) to be furnished are to be furnished in accordance with the Engineer's comments. If the Contractor elects to take exception to any comments, then corrected copies (with supplemental explanatory data) are to be re-submitted to the Engineer similar to a Revise and Resubmit status process.
3. REVISE AND RESUBMIT. Engineer's review found major discrepancies and/or deficiencies, and corrected submittals (in their entirety) are required to determine conformance and intent to the contract documents.
4. REJECTED. Engineer's review concluded that the item(s) submitted do not meet the requirements of the "Or Equal" allowance, or a "Substitution" has been provided without proper approval process. An additional submittal cycle is required containing suitable items to determine conformance and intent of the contract documents.
5. REVIEW NOT REQUIRED BY CONTRACT DOCUMENTS -- The Engineer's review found that the information submitted is not necessary to evaluate conformance and intent with contract documents.

3.07 RE-SUBMITTALS

A. Re-submittals will be handled in the same manner as first submittals. On re-submittals, direct specific attention, in writing on the transmittal letter and on re-submitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. Make corrections to any work done because of this type revision that is not in accordance to the Contract Documents as may be required by the Engineer.

B. Engineer will review all initial information for each submittal. Contractor shall reimburse Contracting Authority for the Engineer's charges for review of additional re-submittals. Contractor will be charged for review of all re-submittals over 20% of the initial submittals.
1. EXAMPLE: If the Contractor has a total of 50 initial submittals, there will be no charge for reviewing a combined total of 60 submittals and re-submittals. There will be a charge to review all submittals and re-submittals in excess of 60.

C. The need for more than one re-submittal or any other delay in obtaining Engineer’s review of submittals, will not entitle Contractor to extension of the contract time unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

D. An assigned review status of REVISE AND RESUBMIT or REJECTED requires the original full number of submittals to be resubmitted free of the Engineers previous correction marks and review status stamp. The Engineer reserves the right to retain the same number of copies for each review cycle.

END OF SECTION 01 3000

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References and Standards.

B. Field Samples.

C. References and Standards.

D. Control of Installation.

E. Testing Services.

F. Control of installation.

G. Tolerances.

H. Manufacturers' Field Services.

1.02 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids or date of Contracting Authority-Contractor Agreement when there are no bids.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with contract documents, request clarification from Engineer before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Engineer shall be altered from contract documents by mention or inference otherwise in any reference document.

1.03 FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.

B. Acceptable samples represent a quality level for the Work.

C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Engineer.

1.04 TESTING SERVICES

A. Contractor shall employ and pay for services of an independent testing agency to perform tests and other testing and inspection specified in individual specification sections and as required by the Engineer.

B. Contracting Authority may choose to have Engineer perform certain inspection and testing activities in addition to those specified as required by the Contractor. Payment for initial Contracting Authority/Engineer inspection and testing will be by Contracting Authority. Payment for Contracting Authority/Engineer retesting required because of non-conformance to specified requirements will be charged to the Contractor by deducting inspection and testing charges from the Contract Sum.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of contract documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with contract documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with contract documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.03 TESTING AND INSPECTION

A. See individual specification sections for testing required.

B. Testing Agency Duties:

1. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
2. Perform inspections, sampling, testing, and other services specified in individual specification sections and as required by the Engineer.
3. Ascertain compliance of materials and mixes with requirements of contract documents.
4. Promptly notify Engineer and Contractor of observed irregularities or non-compliance of Work or products.
5. Perform additional tests and inspections required by Engineer.
6. Submit reports of all tests/inspections specified to Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with contract documents.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of contract documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:

1. Deliver to agency at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs, equipment, tools, storage, and assistance as requested.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
    a. To provide access to Work to be tested/inspected.

b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
c. To facilitate tests/inspections.
d. To provide storage and curing of test samples.

4. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Make arrangements with testing agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Contracting Authority's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Engineer.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

G. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Engineer. Payment for re-testing will be made by the Contractor.

3.04 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given by Manufacturer's Service Representatives to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report in duplicate within 30 days of observation to Engineer for review.

D. Contractor shall provide qualified Service Representative(s), as necessary to:

1. Instruct the Contractor's personnel in the installation, startup, and testing of equipment.
2. Inspect equipment after it is installed to assure that all details of installation are correct and that equipment is prepared for operation in accordance with manufacturer's instructions and recommendations.
3. Check connections to equipment and adjust, or supervise adjustment of, control and indicating devices after equipment has been installed and connected.
4. Fully instruct Contracting Authority's operating personnel in operation and maintenance of equipment.
5. Provide Engineer with duplicate copies of final alignment and clearance measurements on all rotating or reciprocating equipment. Measurements shall clearly identify each piece of equipment.
6. Supervise preliminary operation of equipment and necessary adjustments.

E. Presence of Service Representative will in no way relieve Contractor of any responsibility assumed under Agreement.

F. Work and abilities of Service Representative shall be subject to review of Engineer. If Engineer determines that any Service Representative is not properly qualified, Contractor shall replace Service Representative upon written notification by Engineer.

G. Contractor shall provide continuity in assignment of Service Representative to Work. In event substitution of Service Representative is made which is not at request of Engineer, substitute's time for "familiarization" shall be at Contractor's expense.

H. Execute manufacturer's certificate of proper installation, found at the end of this section.

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

CONTRACTING AUTHORITY:_____ EQPT. SERIAL NO:_____

EQPT. TAG NO.:_____ EQPT./SYSTEM:_____

PROJECT NO.:_____ SPEC. SECTION:_____

I HEREBY CERTIFY THAT THE ABOVE-REFERENCED EQUIPMENT/SYSTEM HAS BEEN: (CHECK APPLICABLE)

____ Installed in accordance with Manufacturer's recommendations.

____ Inspected, checked, and adjusted.

____ Serviced with proper initial lubricants.

____ Electrical and mechanical connections meet quality and safety standards.

____ All applicable safety equipment has been properly installed.

____ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer.)

COMMENTS:_____
_____
_____
_____
_____
_____

I, THE UNDERSIGNED MANUFACTURER'S REPRESENTATIVE, HEREBY CERTIFY THAT I AM (I) A DULY AUTHORIZED REPRESENTATIVE OF THE MANUFACTURER, (II) EMPOWERED BY THE MANUFACTURER TO INSPECT, APPROVE, AND OPERATE HIS EQUIPMENT AND (III) AUTHORIZED TO MAKE RECOMMENDATIONS REQUIRED TO ASSURE THAT THE EQUIPMENT FURNISHED BY THE MANUFACTURER IS COMPLETE AND OPERATIONAL, EXCEPT AS MAY BE OTHERWISE INDICATED HEREIN. I FURTHER CERTIFY THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND ACCURATE.

DATE:_____
_

MANUFACTURER:_____

BY MANUFACTURER'S AUTHORIZED REPRESENTATIVE:_____

(Authorized Signature)

END OF SECTION 01 4000

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Warranty.

C. Re-use of Existing Products.

D. Product Option Requirements.

E. Substitution Limitations and Procedures.

F. Procedures for Contracting Authority-Supplied Products.

G. Transportation, Handling, Storage and Protection.

H. Spare Parts and Maintenance Materials.

1.02 SUBMITTALS

A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
   1. Submit within 15 days after date of Agreement.
   2. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
   1. After review, distribute in accordance with Article on Procedure above and for Record Documents described in Section 01 7800.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
   2. Include identification on each sample, with full Project information.
   3. Submit two samples as specified in individual specification Sections; one of which will be retained by Engineer.
   4. Reviewed samples which may be used in the Work are indicated in individual specification Sections.

1.03 WARRANTY

A. All Products as defined below shall be provided with manufacturer's full warranty against defects in materials and workmanship for 2 years after Date of Substantial Completion, including all parts, labor, and expenses, unless otherwise required in individual specification Sections.

B. Substantial Completion. In addition to the definition provided in the General Conditions, the following applies: Sufficient completion of the project or the portion thereof to permit utilization of the project, or portion thereof for its intended purpose. Substantial completion requires not only that the work be sufficiently completed to permit utilization, but that the Contracting Authority can effectively utilize the substantially completed Work. Determination of substantial completion is solely at the discretion of the Contracting Authority. Substantial completion does not mean complete in accordance with the Contract nor shall substantial completion of all or any part of the project entitle the Contractor to acceptance under the Contract.

C. Final Completion. When the Engineer deems the Project and Punch List fully complete in accordance with Plans and Specification, and when all items including but not limiting to: excess building materials, concrete forms, construction trailers, field offices, and temporary traffic control have been removed from site, the Engineer shall notify the Contracting Authority in writing and recommend final acceptance of work. Sales and Use Tax Forms and Lien Waivers do not have to be completed but are encouraged to be completed as a condition of Final Completion. The date of final completion shall be the date the Engineer's written recommendation of final acceptance to the Contracting Authority.

PART 2 PRODUCTS

2.01 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

B. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by contract documents.

B. Use of products having any of the following characteristics is not permitted:

C. Where other criteria are met, Contractor shall give preference to products that:

1. If used on interior, have lower emissions.
2. If wet-applied, have lower VOC content.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. A request for substitution constitutes a representation that the submitter:

1. Will reimburse Contracting Authority for review or redesign services associated with re-approval by authorities.

3.02 CONTRACTING AUTHORITY-SUPPLIED PRODUCTS

A. Contracting Authority's Responsibilities:

1. Arrange for and deliver Contracting Authority reviewed shop drawings, product data, and samples, to Contractor.
2. Arrange and pay for product delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:

1. Review Contracting Authority reviewed shop drawings, product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Contracting Authority.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
   1. Contractor shall be paid for materials and equipment stored off-site, upon proper documentation of delivery, control and protection of said materials and equipment. Contractor's insurance shall be in full force at this off-site location for complete protection of said materials and equipment.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 6000

SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Instruction of Contracting Authority's Personnel.

D. Warranties and Bonds.

1.02 SUBMITTALS

A. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
2. Submit two copies of preliminary draft hard copies (paper) or proposed formats and outlines of contents before start of Work. Submit one copy of preliminary electronic format before start of work. Engineer will review draft and return one copy with comments.
3. Submit three copies of approved data in final form prior to final inspection or acceptance.
4. Submit five electronic and paper copies of approved data in final form prior to final inspection or acceptance.

B. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with Contracting Authority's permission, submit documents within 10 days after acceptance.
2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Plans.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.

B. Store record documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish main floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

E. Submit documents to Engineer prior to claim for final Application for Payment.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data for particular installation. Organize in consistent format under separate headings for different procedures. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

E. Copy of each warranty, Bond, and service contract issued. Provide information sheet for Contracting Authority's personnel, giving proper procedures in event of failure and instances which might affect validity of warranties or Bonds.

3.03 INSTRUCTION OF CONTRACTING AUTHORITY'S PERSONNEL

A. Prior to final inspection or acceptance, fully instruct Contracting Authority's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.

B. Manual for equipment and systems shall constitute basis of instruction. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

C. Any presentation or training materials shall be provided to the Contracting Authority in format presented (i.e. Microsoft format, Office 365 or less).

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
1. Description of unit or system, and component parts.
2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include predicted life of parts subject to wear and list of items recommended to be stocked as spare parts.

I. Provide control diagrams by controls manufacturer as installed.

J. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

K. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

L. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

M. Content for each electrical and electronic system, as appropriate.
   1. Description of system and component parts:
      a. Function, normal operating characteristics, and limiting conditions.
      b. Performance curves, engineering data, and tests.
      c. Complete nomenclature and commercial number of replacement parts.
   2. Circuit directories of panel boards:
      a. Electrical service.
      b. Controls.
      c. Communications.
   3. As-installed color coded wiring diagrams.
   4. Operating procedures:
      a. Routine and normal operating instructions.
      b. Sequences required.
      c. Special operating instructions.
   5. Maintenance procedures:
      a. Routine operations.
      b. Guide to "trouble-shooting".
      c. Disassembly, repair, and assembly.
      d. Adjustment and checking.
   6. Manufacturer's printed operating and maintenance instructions.
   7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

N. Prepare and include additional data when need for such data becomes apparent during instruction of Contracting Authority's personnel.

O. Additional Requirements: As specified in individual product specification sections.

3.05 OPERATION AND MAINTENANCE MANUALS (HARD COPIES - PAPER)

A. Prepare instructions and data by personnel:
   1. Trained and experienced in maintenance and operation of described products.
   2. Familiar with requirements of this section.
   3. Skilled as technical writers to extent required to communicate essential data.
   4. Skilled as draftsmen competent to prepare required drawings.

B. Prepare data in the form of an instructional manual for use by Contracting Authority's personnel.

C. Format: 8 1/2 by 11 inch paper with 20 pound minimum, white, for typed pages.

D. Binders: Commercial quality, 8 1/2 by 11 inch binders with durable and cleanable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
   1. Label spine of binder with identity of general subject matter covered in manual.

E. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify: title of Project, identity of separate structure as applicable, and identity of general subject matter covered in manual.

F. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

H. Contents: Neatly typewritten table of contents for each volume, arranged in systematic order with consecutive page numbers.
   1. Contractor, name of responsible principal, address, and telephone number.

2. List of each product required to be included, indexed to content of volume.
3. List, with each product, name, address, and telephone number of:
    a. Subcontractor or installer.
    b. Maintenance contractor, as appropriate.
    c. Identify area of responsibility of each.
    d. Local source of supply for parts and replacement and list of recommended spare parts.
4. Identify each product by product name and other identifying symbols as set forth in Contract documents, including nameplate information and shop order numbers for each item of equipment furnished.
5. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
6. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

I. Provide 30 days prior to actual start-up.

3.06 OPERATION AND MAINTENANCE MANUALS (ELECTRONIC)

A. Prepare instructions and data by personnel:
1. Trained and experienced in maintenance and operation of described products.
2. Familiar with requirements of this section.
3. Skilled as technical writers to extent required to communicate essential data.
4. Skilled as draftsmen competent to prepare required drawings.

B. Prepare data in the form of an instructional manual for use by Contracting Authority's personnel.

C. Format: Electronic copy shall be delivered on a unique CD-ROM in Adobe Acrobat's Portable Document Format (PDF) and Microsoft Word versions. The PDF file(s) shall be fully indexed using the table of contents, searchable with thumbnails generated. The Microsoft Word files shall be easily found using unique file naming conventions with reference list.

D. Cover: Identify each CD-ROM with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify: title of Project, identity of separate structure as applicable, and identity of general subject matter covered in manual.
1. Contents: Neatly typewritten table of contents for each volume, arranged in systematic order.
2. List of each product required to be included, indexed to content of volume.
3. List, with each product, name, address, and telephone number of:
    a. Subcontractor or installer.
    b. Maintenance contractor, as appropriate.
    c. Identify area of responsibility of each.
    d. Local source of supply for parts and replacement and list of recommended spare parts.
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents, including nameplate information and shop order numbers for each item of equipment furnished.

3.07 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Contracting Authority's permission, leave date of beginning of time of warranty until Date of Substantial Completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION 01 7800

SECTION 09 9000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Responsibility for surface preparation and primary coating of equipment and motors shall be equipment manufacturers. Equipment to be finish coated and coating system is identified in equipment specification section(s).

B. Field application of paints.

C. Painting materials and methods for conduit identification specified in Section 26 0553.

D. See Schedule - Surfaces to be Finished, at end of this Section.

1.02 REFERENCES

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

C. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. AWWA C204 - Chlorinated Rubber-Alkyd Paint Systems for the Exterior of Above Ground Steel Water Piping.

F. AWWA D102 - Painting Steel Water Storage Tanks.

G. NACE (IMP) - Industrial Maintenance Painting; NACE International; current edition.

H. NPCA (National Paint and Coatings Association) - Guide to U.S. Government Paint Specifications.

I. PDCA (Painting and Decorating Contractors of America) - Painting - Architectural Specifications Manual.

J. SSPC SP-1 - Surface Preparation Specification No. 1 - Solvent Cleaning.

K. SSPC SP-2 - Surface Preparation Specification No. 2 - Hand Tool Cleaning.

L. SSPC SP-3 - Surface Preparation Specification No. 3 - Power Tool Cleaning.

M. SSPC SP-5 - Surface Preparation Specification No. 5 - White Metal Blast Cleaning.

N. SSPC SP-6 - Surface Preparation Specification No. 6 - Commercial Blast Cleaning.

O. SSPC SP-7 - Surface Preparation Specification No. 7 - Brush-Off Blast Cleaning.

P. SSPC SP-10 - Surface Preparation Specification No. 10 - Near-White Metal Blast Cleaning.

Q. SSPC SP-11 - Surface Preparation Specification No. 11 - Power Tool Cleaning to White Metal.

R. SSPC SP-12 - Surface Preparation Specification No. 12 - High Pressure Water Cleaning.

S. SSPC SP-13 - Surface Preparation Specification No. 13 - Concrete Cleaning.

T. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings.

1.03 DEFINITIONS

A. Conform to ASTM D 16 for interpretation of terms used in this section.

B. Coatings: Heavy duty finishes for use on any surfaces, especially surfaces subject to submerged, high moisture, splash, or chemical environment.

C. Ambient Conditions:
   1. Chemical: Surface subject to corrosive chemical splash or fumes.
   2. Moist: Surface subject to wet areas such as shower rooms and rooms with open tanks.

3. Normal: Surface subject to normal temperatures and humidity such as found in offices and corridors.

D. Splash: Surface subject to frequent washing and chemical splash.

E. Submerged P: Surface submerged in potable water plus 1.0 foot above high liquid level.

F. Submerged NP: Surface submerged in nonpotable liquid plus 1.0 foot above high liquid level.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on all finishing products.

C. Samples: Actual color samples available for each type of coating scheduled. Colors to be approved by Contracting Authority.

D. Samples: Submit two paper chip samples, 2 by 2 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.

E. Literature:
1. Submit manufacturer's literature stating application recommendations and generic makeup of each type of coating schedule.
2. Substitutions: For coatings not specified herein, provide substitute manufacturer's literature with specified coating literature for Engineer to make proper evaluation.

F. Letter of Certification/Shop Painting:
1. Contractor has option of shop coating materials and equipment partially or totally.
2. Submit the following for factory-applied coatings:
   a. Coating used.
   b. Manufacturer's written certificate factory-applied coating system identical to, or exceeding, requirements specified herein.
   c. Requirements for touch-up or coating.
   d. History of coating performance in same environment.
3. Submit the following for factory-applied primer.
   a. Primer used.
   b. Contractor's certification factory-applied primer compatible with field-applied finish coat.
4. Schedules:
   a. Submit schedule of proposed coating systems within 90 calendar days of Award of Contract.
   b. Complete schedule of proposed coating systems containing same information as indicated in coating schedule.

G. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

H. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.05 QUALITY ASSURANCE

A. Sampling of Materials:
1. Engineer reserves the right to select unopened containers of materials furnished on job and have materials tested at approved laboratory. Contracting Authority will pay for first tests.
2. Retests of rejected materials and tests of replacement materials shall be paid for by the Contractor.
3. Remainder of contents of containers not required for testing will be returned to Contractor.

B. Field Quality Control:

1. Before beginning work, finish one complete room, space or item of each color scheme required, showing selected colors, finished texture, material, and workmanship. After approval, sample rooms or items shall serve as standard for similar work throughout the building.
2. If coverage is not acceptable to the Engineer, Engineer reserves the right to require extra application of paint at no extra cost to Contracting Authority.
3. Work at site where coat of material applied will be inspected by Engineer before application of succeeding specified coat, otherwise no credit for coat applied will be given and Contractor automatically assumes responsibility to recoat work in question. Furnish Engineer report of particular coat applied and when completed for inspection to comply with above.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 °F and a maximum of 90 °F, in ventilated area, and as required by manufacturer's instructions.

D. Avoid danger of fire: Deposit cleaning rags and waste materials in metal containers having tight covers or remove from building each night. Provide fire extinguishers of type recommended by coating manufacturer in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvents. Store solvents in safety cans.

E. Empty containers shall have labels cancelled and be clearly marked as to use.

F. Upon project completion, remaining material will become property of Contracting Authority. Seal material as required for storage, marked as to contents and shelf life, and store where required by Contracting Authority.

G. Protect floor and walls of storage area from splatter or disfiguration.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

C. Apply no finish in rooms where dust is being generated.

D. Minimum Application Temperatures for Latex Paints: 45 °F for interiors; 50 °F for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 °F for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Maintain interior temperature and relative humidity of space, as recommended by coating manufacturer, 24 hours before applying and until coating is cured.

G. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

H. Provide adequate lighting.

1.09 PROJECT/SITE CONDITIONS

A. Protection:
1. Cover material and surfaces, including floors and open tanks, adjoining or below work in progress with clean drop cloths or canvas.

2. Remove hardware, accessories, plates, lighting fixtures, and similar items or provide protection by masking. Upon completion, replace above items or remove protection and clean.
3. Maintain manufacturer's environmental requirements while coating dries.

B. Cooperation: Work shall be scheduled and coordinated with other trades and shall not proceed until other work and/or job conditions are, in the judgment of the Contracting Authority's Construction Inspector, as required to achieve satisfactory results.

1.10 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Supply 1 gallon of each color, type, and surface texture; store where directed.

C. Label each container with color, type, texture, and locations in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:
1. Sherwin-Williams Co.
2. Tnemec.
3. Engineer approved equivalent.

2.02 PAINTS AND COATINGS - GENERAL

A. Materials selected for coating system for each type of surface shall be product of same manufacturer.

B. Paints and Coatings: Ready mixed.

C. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
2. For good flow and brushing properties.
3. Capable of drying or curing free of streaks or sags.

D. Color shall be formed of pigments free of lead, lead compounds or other materials which might be affected by presence of hydrogen sulfide or other gases likely to be present at project.

E. Coatings shall meet surface burning characteristics as required by code and established by ASTM E 84.

F. Any surface not listed in the schedule of materials, shall be painted as scheduled for similar surfaces. In general, all non-ferrous metals, aluminum, stainless steel, chrome, and copper will not be painted.

2.03 SCHEDULE - COLORS

A. Colors shall be selected and approved by Contracting Authority.

B. Prior to beginning work, Engineer will provide color coordinating schedule. System color coding shall comply with this Section.

C. Coat access doors, electrical distribution panels, grilles, and heating units to match color of adjacent wall or ceiling surfaces.

D. In areas scheduled for finishing coat exposed piping, conduit, and ducts to match adjacent or near walls or ceilings, except for color coding.

E. Rooms and spaces may have certain walls coated different color than other walls in same room and ceilings and trim may be different color or colors than walls.

F. Equipment Colors (Equipment includes equipment, structural supports, and fasteners): Coat equipment same color as piping it serves.

G. Where patching and repair occurs in rooms or spaces not scheduled for finish, finish to blend or match existing colors and surfaces. Carry finish to a natural boundary between new work and existing.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

2.05 MIXING AND TINTING

A. Each coat - primer, intermediate, finish - shall be slightly darker than preceding coat to visually indicate adequate coverage, unless otherwise approved by the Engineer.

B. Tint undercoats similar to finish coats, but with sufficient variations to distinguish between coats.

C. Adjust stained finishes as necessary to obtain identical appearance on veneer and solid stock.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

B. If surfaces to be finished cannot be put into proper condition or finished by customary cleaning, sanding, and puttying operations or if surfaces were improperly primed by others, report defects to Engineer, in writing, or assume responsibility and correct unsatisfactory finish resulting from improper surfaces. Commencement of work indicates acceptance of surfaces.

C. Materials removed and replaced to correct defects due to work placed on unsuitable surfaces shall be at Contractor's expense.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Plaster and Gypsum Wallboard: 12 %.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 %.
3. Interior Wood: 15 %, measured in accordance with ASTM D4442.
4. Exterior Wood: 15 %, measured in accordance with ASTM D4442.
5. Concrete Floors: 8 %.

3.02 PREPARATION

A. Surfaces, including floors, shall be clean, dry, and free of loose dirt, dust, and foreign matter before applying coating.

B. Comply with coating manufacturer's recommendations for surface preparation.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.

E. Marks: Seal with shellac those which may bleed through surface finishes.

F. Joints: All joints shall be caulked and sealed. This includes the joint or gap between the threaded flange and the pipe on all progress piping. Caulking shall be a paintable polyurethane or silicone sealant such as BASF Sonolastic NP1, or an Engineer approved equivalent. Paint over sealant to match pipe color.

G. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

H. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

I. Masonry: Remove loose grit and mortar. Masonry must be cured and dry and free of surface conditioners that limit adhesion of protective coatings.

J. Stucco/Concrete:
   1. Do not begin surface preparation until 30 days after stucco concrete is placed.
   2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent or other suitable cleaning methods.
   3. Abrade, per SSPC-SP 13 (ASTM D 4259) to remove laitance, form release agents, and solid contaminants. Perform sufficiently close to surface to open up surface voids, bug holes, air pockets, and other sub-surface irregularities, but so as not to expose underlying aggregate. Resulting surface should be clean and uniform as required by coating manufacturer. If brush-off blasting impractical, acid etch with muriatic acid solution and wash with water or neutralizing agent as required by coating manufacturer.

K. Plastic:
   1. Solvent clean pipe in accordance with manufacturer's recommendations.
   2. Hand sand with medium grit sandpaper to provide tooth for coating system.
   3. Large areas may be power sanded or brush-off blasted, provided sufficient controls employed so surface roughened without removing excessive material.

L. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound and sand flush with surface. Spot prime defects after repair.

M. Plaster Surfaces to be Painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

N. Asphalt, Creosote, or Bituminous Surfaces to be Painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.

O. Insulated Coverings to be Painted: Remove dirt, grease, and oil from canvas and cotton.

P. Copper Surfaces to be Painted: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.

Q. Ferrous Metal:
   1. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
   2. Prepare welds and adjacent areas to remove undercutting or reverse ridges on weld bead, weld spatter on or adjacent to weld or area to be coated, and sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
   3. Coat surfaces same day prepared and prior to "rust bloom". Re-prepare surfaces starting to rust before coating. Surface preparation shall be verified in accordance with SSPC-Vis 1, Vis 3, and ICRI templates.
   4. Cleaning Methods:
      a. Workmanship for metal surface preparation as specified shall conform to current SSPC specifications as follows;
         1) Solvent Cleaning: SP-1.
         2) Hand Tool Cleaning: SP-2.
         3) Power Tool Cleaning: SP-3.
         4) White Metal Blast Cleaning: SP-5.
         5) Commercial Blast Cleaning: SP-6.
         6) Brush-off Blast Cleaning: SP-7.
         7) Pickling: SP-8.

8) Near-White Metal Blast Cleaning: SP-10
9) Power Tool Cleaning to White Metal: SP-11.
10) High Pressure Water Cleaning: SP-12.
11) Concrete. Cleaning: SP-13.

b. Wherever "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning" or similar words of equal intent are used in specifications or coating manufacturer's specifications, they shall be understood to refer to applicable SSPC specifications listed above.

c. Use hand tools to clean areas that cannot be cleaned by power tools.

5. Shop Preparation: Equipment, structural steel, metal louvers, and similar items may be shop-prepared and primed at Contractor's option. Centrifugal wheel blast cleaning acceptable alternate to shop blast cleaning. Clean and prime in accordance with this section.
6. Field Touch-up: Sandblast items and equipment as specified to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures, and safety equipment for personnel shall conform to SSPC.

R. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

S. Galvanized Metal:
1. Touch-up damaged areas with zinc-rich primer.
2. Prepare galvanized metal surfaces to be coated as required for system being applied.

T. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

U. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

V. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

W. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer.

X. Metal Doors and panels to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. General:
1. Apply products in accordance with manufacturer's instructions.
2. Apply paint, enamel, and varnish with suitable brushes, rollers, or spraying equipment.
3. Spread evenly and flow on smoothly without runs, lumps, or sags.
4. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.
5. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
6. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
7. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
8. Coat bright metal portion of duct visible through grille when viewed from distance of 1 feet from grille.
9. Sand metal surfaces lightly between coats to achieve required finish.
10. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
11. Manufacturer-Applied Coating System:

a. Repair abraded areas on factory-finished items in accordance with manufacturer's directions.
b. Blend repaired areas into original finish.

12. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
13. When covered and uncovered pipes and ducts pass through a finished space, paint with primer-sealer; then finish with same type of finish coat as used on immediately adjacent wall or ceiling surface.
14. Leave all parts of moldings and ornaments clean and true to details with no undue amount of finish in corners and depressions.
15. Coverage and hide shall be complete. When color, stain, dirt, or undercoats show through final coat of paint the surface shall be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage.
16. Doors: Doors shall be fitted prior to finish work. All door edges (including top and bottom) shall be finished the same as the door face - with stain, sealer, finish, and finished smooth to the touch. Apply one coat finish on tops and bottoms of doors after fitting. Doors shall be stained, sealed, and finished behind all hardware. All surfaces of door cutouts shall be properly sealed prior to installation of door glass, grilles, or other accessories.

B. Priming and Sealing:

1. Refer to coating schedule for specific products.
2. Shop:
   a. Shop primer for ferrous metal shall comply with SSPC guidelines, and as specified in coating schedule of this specification.
   b. Inspect shop-primed items at job site for compliance with contract documents. Schedule inspection with Engineer.
   c. Hand or power sand chipped, peeled, or abraded primer and feather edges. Spot prime areas with specified primer.
   d. Prior to application of finish coats, clean shop-primed surfaces free of dirt, oil, and grease.
   e. Prepare and prime holdback areas as required for specified coating system.
3. Field:
   a. Prime surfaces of woodwork indicated to receive coating.
   b. Prepare holdback area for welding and prime after welding as required for specified coating system.

3.04 CLEANING

A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Before substantial completion, remove masking, coating, and other material from floors, glass and other surfaces and remove rubbish and accumulated materials of whatever nature not caused by other trades from premises and leave in clean, orderly condition, with floors broom clean.

C. All glass throughout shall have all paint or varnish spots and brush marks removed and, upon completion of the painting work, shall be washed and polished both sides.

D. All glass that is scratched or damaged by the painter's work or while cleaning off the paint from the glass shall be replaced.

E. Hardware and other unpainted surfaces shall be cleaned using lacquer thinner or paint remover. No edge tools or abrasives will be permitted.

3.05 SCHEDULE - SURFACES TO BE FINISHED

A. Paint everything except as indicated below:

1. Fire rating labels, equipment serial number and capacity labels.
2. Stainless steel items.

3. Aluminum Items.
4. Electrical conduits and boxes.
5. Factory-finished electrical motor control panels (MCC) and main instrument panels (MIP), flow indicators, and related equipment.
6. Polyvinyl Chloride (PVC) and Polyethylene (PE) chemical feed piping. Refer to the piping color coding schedule at the end of this specification for color.
7. Underground equipment and piping.
8. Surfaces above suspended ceiling systems (unless color coded).
9. Factory finished trim.
10. Aluminum or fiberglass ductwork or aluminum faced duct insulation.
11. Aluminum or fiberglass louvers or trim.
12. Aluminum or fiberglass doors and frames or trim.
13. Concrete tanks.
14. Concrete floors.
15. Brick-faced exterior walls.
16. Precast concrete wall panels - exterior only.
17. Precast concrete double tee roof members.

B. Paint the surfaces described below under Schedule - Paint Systems.

C. Coordinate painting schedule with the General Contractor and Subcontractor.

D. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
1. Paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, and hangers, brackets, collars and supports , unless otherwise indicated.
2. Paint exposed conduit and electrical equipment occurring in finished areas, unless otherwise indicated.
3. Paint all equipment, including that which is factory-finished, exposed to weather or to view on the roof and outdoors.
4. Paint shop-primed items occurring in finished areas.
5. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
6. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
7. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
8. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
9. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

E. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

3.06 SCHEDULE - PAINT SYSTEMS

A. General
1. Unless otherwise noted, Tnemec products are identified in this schedule to establish quality and type desired.
2. Scheduled thickness or coverage rate is as recommended by Tnemec. If other manufacturers are used, manufacturer's requirements shall be followed, but in no case shall thickness or coverage rate be less than Tnemec.
3. DFT = dry film thickness (mils/coat). DFT shown is for spray application. Additional coats may be required if brushed and rolled.
4. sfpg = sq ft/gal (per coat).
5. Examples of items to be coated are not all inclusive.

B. Interior walls of the new building shall be painted. Interior floor and ceiling shall not be painted.

C. New interior and exterior piping, equipment, and appurtenances regardless of type of factory-applied finish, where color coding required.

D. New exposed interior and exterior structural steel surfaces.

E. Schedule:
   1. System 3A (Cast Iron and Ductile Iron, Interior Moist/Interior Splash, Semi-Gloss Sheen).
      a. Application: Cast Iron and Ductile Iron pipes, fittings, valves, etc.
      b. Preparation: Ferrous Metal SP-6.
      c. System:
         1) Primer: One coat/2.5 to 3.0 DFT "N140 Pota-Pox Plus."
         2) Top Coat: One coat/4.0 to 6.0 DFT "135-Color Chembuild."
   2. System 4A (Cast Iron and Ductile Iron, Exterior/Exterior Splash, Gloss or Semi-Gloss Sheen).
      a. Application: Cast Iron and Ductile Iron pipes, fittings, valves, etc.
      b. Preparation: Ferrous Metal SP-6.
      c. System:
         1) Primer: One coat/2.5 to 3.0 DFT "N140 Pota-Pox Plus."
         2) Top Coat: One coat/3.0 to 4.0 DFT "740-Color UVX".

F. Process mechanical piping color coding schedule:
   1. Water Lines:
      a. Potable: Dark Blue.
      b. Hot Water: Blue with Red Bands.
      c. Non-potable: Blue with "Non-Potable" labels.
   2. Waste Lines:
      a. Sludge: Dark Brown.
      b. Sewer (Sanitary or Other): Dark Grey.
   3. Wastewater Lines:
      a. Raw Sludge: Brown with black bands.
      b. Sludge Recirculation Suction: Brown with yellow bands.
      c. Sludge Draw off: Brown with orange bands.
      d. Sludge Recirculation Discharge: Brown.
      e. Nonpotable Water: Blue with black bands.
      f. Potable Water: Blue.
      g. Sewage (wastewater): Gray.
      h. Compressed Air: Green.
      i. Contents and direction of flow shall be stenciled on the piping in a contrasting color.
   4. Chemical Lines: Use tape only for identification. Use a 2 inch wide tape every 5 feet.
      a. Liquid Coagulant: Orange.
      b. Caustic Soda: Yellow with Green Band.
      c. Sodium Hypochlorite: Yellow.
      d. Sulfuric Acid: Yellow with Red Band.
   5. Other Lines:
      a. Compressed Air: Dark Green.
      b. Natural Gas: Red.
      c. Drain and Vent: Black.
      d. Electrical Conduit: Same color as walls.
   6. In situations where two colors do not have sufficient contrast to easily differentiate between them, a 6 inch band of contrasting color should be on one of the pipes at approximately 30 inch intervals. The name of the liquid or gas should also be on the pipe. In some cases it may be advantageous to provide arrows indicating the direction of flow.

3.07 FINAL TOUCH-UP

A. Prior to substantial completion, examine coated surfaces and retouch or refinish to leave surfaces in condition acceptable to the Engineer.

END OF SECTION 09 9000

SECTION 22 1116
DUCTILE IRON PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed requirements for various ductile iron piping products. Some products specified in this section may not be required for this Contract. Piping system Specification section(s) and Drawings identify particular ductile iron piping products to be provided under this Contract.

1.02 REFERENCES

A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

B. ASTM B 1000 - Standard Practices for Casting Preparation and Test Procedure of Porcelain Enamel-Lined Pipe, Fittings, and Valves for Use in the Municipal Wastewater, Sewage, and Water Treatment Industry.

C. ASTM C 283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.

D. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

E. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

F. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.

G. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.

H. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings.

I. AWWA C115 - Flanged Ductile-Iron Pipe with Threaded Flanges.

J. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

K. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.

L. AWWA C153 - Ductile-Iron Compact Fittings, 3 inch Through 16 inch, for Water or Other Liquids.

M. AWWA C606 - Grooved and Shouldered Joints.

N. ANSI A21.14 - Ductile-Iron Fittings 3-in. Through 24-in., for Gas.

O. ANSI A21.52 - Ductile-Iron Pipe, Centrifugally Cast, In Metal Molds or Sand Lined Molds for Gas.

P. ANSI B18.2.1 - Square and Hex Bolts and Screws Inch Series.

Q. ANSI B18.2.2 - Square and Hex Nuts.

R. AWS A5.6 - Specification for Covered Copper and Copper Alloy Arc Welding Electrodes.

S. AWS A5.15 - Specification for Welding Electrodes and Rods for Cast Iron.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 3000.

B. Product Data: Include Manufacturer's specifications, catalog cuts, and literature:

1. Pipe.
2. Outside coatings.
3. Inside linings.
4. Mechanical and push-on joints.
5. Flanged joints.
6. Grooved joints.
7. Standard fittings.
8. Special fittings.
9. Wall pipe and floor pipe.

10. Polyethylene encasement.

C. Submit outside coating system for buried, interior, exterior, and submerged piping locations. Include submittal information specified in Section 09 9000.

D. Submit product data and coating system information specified above in one complete submittal.

E. Shop Drawings showing layout for ductile iron piping systems shall be submitted in accordance with and transmitted under appropriate piping system specification section.

F. A letter from the pipe and fitting manufacturers stating the product(s) are supplied new from the manufacturer and all linings required by the specifications for the pipe and fittings are supplied by the manufacturer and are covered by the manufacturer's warranty.

PART 2 PRODUCTS

2.01 MATERIALS

A. Liquid and Air Service Pipe: AWWA C151, ductile iron.

B. Minimum Thickness Class:
1. Flanged Joint Pipe: Thickness Class 53.

2.02 INSIDE LINING

A. Ceramic Epoxy 40-60 mil thickness, Protecto 401, SP-2000, Permox-CTF, or Engineer approved equivalent, or as noted in pipeline schedule. Manufacturer shall provide testing report for lining materials including results of holiday test using no less than 62.5 volts per mil.

2.03 JOINTS

A. Joint Type:
1. Liquid and air services in buried locations shall be mechanical or push-on joint.
2. Liquid and air service in locations other than buried shall be flanged or grooved end joint.
3. As shown on Drawings if different than specified above for services and locations.

B. Flanged Joints:
1. Flanged pipe for liquid and air service shall be in accordance with AWWA C115.
2. Flanged pipe for gas service shall be in accordance with AWWA C115 and ANSI A21.52. In addition to pipe marking specified in AWWA C115 and ANSI A21.52, conspicuously stamp each flanged pipe with words "AIR TESTED".
3. Fabrication of flanged pipe, including assembly of flange on pipe shall be performed by pipe manufacturer in accordance with AWWA C115. Assembly of flange on pipe outside of manufacturer's shop is unacceptable.
4. Flange material for flanged pipe shall be ductile iron. Flanged pipe with gray iron flanges is not acceptable.
5. Gasket material shall be suitable for service and maximum operating temperature of piping system as specified in Piping System Specification Section 40 0620. Torque requirement of gaskets shall be less than torque rating of flange, bolts, and nuts.
6. Gaskets shall be full face, 1/8 inch thick, and conform to dimensions shown in Appendices to AWWA C110 and C115.
7. Bolts:
   a. Size, length, and number as shown in AWWA C110 and C115.
   b. Material: Stainless steel, ASTM A193, Grade B8M.
   c. Dimensions: ANSI B18.2.1, heavy hex.
8. Nuts:
   a. Size, length, and number as shown in AWWA C110 and C115.
   b. Material: Stainless steel, ASTM A194, Grade 8M.
   c. Dimensions: ANSI B18.2.2, heavy hex.

2.04 FITTINGS

A. Pressure rating shall be 250 psi, minimum.

B. Standard fittings for liquid and air service shall be as follows:

1. Flanged Joint Fittings:
    a. Ductile iron.
    b. AWWA C110.
    c. Flange dimensions in accordance with AWWA C115.

C. Special fittings for liquid and air service, not included in AWWA standards, shall be manufacturer's standard, based on AWWA design principles, and in compliance with applicable requirements of AWWA standards.

D. Standard fittings for gas service shall be as follows.
1. Flanged Joint:
    a. ANSI A21.14, ductile iron.
    b. Flange dimensions in accordance with AWWA C115.

E. Special fittings for gas service, not included in ANSI standard, shall be manufacturer's standard, based on ANSI design principles, and in accordance with applicable requirements of ANSI standard.

F. Wall Pipe and Floor Pipe:
1. Ductile iron.
2. Wall thickness of body equal to or greater than wall thickness of connecting pipe.
3. Flanges set flush with face of concrete shall be tapped for stud bolts.
4. Collar dimensions as shown on Drawings.
5. Collar cast integral with pipe or fabricated by welded attachment of collar to pipe.
6. Fabricated wall pipe and floor pipe shall be as follows.
    a. Rated for dead end thrust due to 250 psi internal pressure.
    b. Ductile iron collar welded continuously around pipe on both sides of collar.
    c. Weld in pipe manufacturer's shop by qualified welder.
    d. Electrodes: AWS A5.15, Class ENiFe-CI or AWS 5.6, Class ECuAl-2.

2.05 OUTSIDE COATING

A. Surface preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with Section 09 9000, System 3A for interior pipe and System 4A for exterior pipe. Non-buried piping shall not have the asphaltic coating, but shall be provided with the specified shop prime coat.

PART 3 EXECUTION

3.01 JOINT ASSEMBLY

A. Flanged joint in accordance with flanged pipe manufacturer's written instructions, and gasket manufacturer's written instructions.

3.02 WALL PIPE

A. Support by formwork to prevent contact with reinforcing steel.

END OF SECTION 22 1116

SECTION 25 1316
BOXES, PANELS, AND CONTROL CENTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pump Control Panel - CP1.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Submit panel layouts: Front and back.

C. Submit schematic diagrams, fully documented.

D. Product Data: Provide for all components.

1.03 SERVICE REPRESENTATIVE

A. Provide qualified service representative to perform functions described in 01 4000 and to sign Certificate of Proper Installation attached at end of Section 01 4000.

PART 2 PRODUCTS

2.01 HARDWARE AND COMPONENTS SPECIFICATIONS

A. This section shall specify various items of hardware, components, and equipment to be utilized in the controls system.

B. All panels shall be UL labeled for UL 508A. Panels with Intrinsic safe circuits shall be UL labeled for UL 698A in addition to 508A.

C. Adequate transient surge voltage protection shall be provided to protect the solid state equipment from voltage surges

D. All electrical components shall be UL approved and are to be of general purpose, heavy duty grade. Custom designed components not readily available from conventional industry sources shall not be used.

2.02 IDENTIFICATION

A. All components, door mounted and interior, shall be labeled. Use mnemonic labels (e.g. NTFV1 for north tank flow valve No. 1) as much as possible. Use each item's official tag name and number.

B. Nameplates on the exterior of the panel shall be reverse engraved, white letters on black background (or otherwise as indicated), with the exposed face flat and smooth. Standard nameplate size of 0.75 inch by 2.5 inches.

C. All components on the interior of the panel shall be labeled with nameplates permanent markings which shall identify the device, cross-referencing it with the schematic drawings.

D. This shall include every relay, time delay, switch, and all other system components.

E. All individual wires, both inside control panels/consoles and at each remote instrument or device, shall be wire tagged at each end with a unique number matching the wire number identification on the schematic. Wire tags shall be plastic heat shrunk tags, not paper.

F. Multiple conductor cable, such as ribbon cable with a permanent plug connector at each end, need not be marked.

2.03 SPARE PARTS

A. The following spare parts shall be provided:

1. Two units or 10% of the total quantity of each used, whichever is greater, spare indicator lamps, relays and time delays of each type.
2. Ten control fuses of each type and size.

2.04 CONTROL RELAYS

A. All control relays shall be plug-in style, provided with dust protecting enclosure and identical, 11 blade plug-in bases with screw terminals. All relays in all panels shall be standardized as much as possible to one or minimum number of relay manufacturers and models.

B. Relays shall have an indication flag to indicate the energized status of the relay.

C. Any relay whose operating frequency would indicate a life of less than twenty years, shall be solid state, either plug-in as above, or with screw terminals.

2.05 SWITCHES AND PUSHBUTTONS

A. All panel mounted rotary selector switches and pushbuttons shall be heavy duty, NEMA type 4/13, watertight/oiltight design, 30.5 mm, with screw-type termination.

B. Two-position, three-position, and four-position rotary selector switches are required as shown on the panel layout drawings and described in the functional description

C. Include secondary contact block for use in transmitting switch position indication to control system and legend plates.

D. Approved manufacturers:
1. Allen-Bradley. Model: Bulletin 800T.
2. Square D. Model: Class 9001 Type K.
3. Engineer approved equivalent.

2.06 DOOR SWITCHES

A. All door switches shall be nose plunger type, housed within a 14 gauge steel mounting plate.

B. Contact rating: 10 A at 120 VAC.

C. Approved manufacturers:
1. Saginaw. Model: SCE-LSA.
2. Hoffman. Model: ALFSWD.
3. Engineer approved equivalent.

2.07 ENCLOSURE LIGHTS

A. All enclosure lights shall meet or exceed IP 20 classification .

B. LED type light capable of 120 degree angle of illumination.

C. Input: 120 VAC.

D. Output: 400 Lm.

E. Approved manufacturers:
1. Hoffman. Model: LEDA1S35.
2. Stego. Model: LED 025.
3. Engineer approved equivalent.

2.08 INDICATOR LIGHTS

A. All indicator lights shall be five-element LED type with lamp rated for illumination of 10,000 hour operating life. Dim glow lights are not a suitable alternate.

B. Power to the lamps shall be limited for extended operational life.

C. Lamps shall be replaceable from the front of the panel without the use of tools.

D. Lenses shall be screw-type to allow easy interchange for color coding selection, 30.5 mm.

E. All lamps shall be the same voltage, low voltage lamps, either 12V or 24V.

F. Provide integral push-to-test switch design.

G. Approved manufacturers:
1. Allen-Bradley: Model: Bulletin 800T.
2. Square D: Model: Class 9001 type J.
3. Engineer approved equivalent.

2.09 CONTROL PANEL SURGE PROTECTION

A. Phoenix Contact Mains-Plugtrab PT series.

B. Engineer approved equivalent.

2.10 LOOP ISOLATION

A. Provide a surge protection device on all input and output circuits (analog, discrete, or digital communication) that enter or leave the building or structure in which the control panel is located.

B. Manufacturers:
1. Innovative Technology Type OEM-D22.
2. EDCO Type PC642.

2.11 CONTROL PANEL ELECTRICAL WORK

A. Wiring:
1. Internal panel wiring shall be completed at the factory in a professional manner.
2. Wiring shall be bundled in wire duct for ease of field modification or tracing, except for the required bundling with wire tires on the run to the door mounted components.
3. All field interconnections shall be made to tubular clamp style terminal strips which shall be marked with the wire numbers of the connecting wires.

B. Materials and protection:
1. All wire shall be stranded copper, of adequate ampacity in order to provide the rated operating voltage for all components under all extremes of operation.
2. Wiring which carries low voltage signals subject to transients shall be protected by isolation and shielding.
3. Insulation - Type MTW cabinet wiring.
4. Insulation - Type THWN, THHN Field wiring.

C. Identification:
1. Each wire shall be identified with an easily readable permanent wire marker, identifying the wire number. Numbering system shall be consistent throughout system, identifying all terminals.
2. The "record" schematics shall identify that wire number for future maintenance requirements.
3. An exception will be made for ribbon cable connectors which are provided with a permanent connector, providing the cables can be easily unplugged and reinstalled without confusion.

D. Connections and mounting:
1. All devices, regardless of location in or on the panel, shall be mechanically mounted and electrically wired in a manner allowing easy removal, replacement, or exchange without requiring a soldering iron or special tools.
2. All connections shall be of screw-type or plug-type connectors.

2.12 CONTROL PANEL

A. General
1. Control panels shall include all items and components as indicated on drawings and specified herein. Provide all necessary internal components and power supplies necessary to perform all functions as previously described.
2. Provide one duplex convenience outlet and one service light in each panel section.
3. Electrical service to the control panel as indicated on drawings.
4. Sufficient expansion space shall be provided in the enclosure to allow a ten percent expansion of the control system requirements. Five percent spare terminals shall be provided with the original installation and space for an additional five percent shall be available for later addition.
5. Mounting track shall be provided for an expansion of up to 10% additional relays.

B. Construction and finish:

1. Control panels shall be manufactured from a UL listed, NEMA Type enclosure, all welded 14 gage cold rolled steel construction, with stainless steel door hardware, continuous piano hinge, and oil resistant gasket, except as specifically indicated otherwise. This specification for construction and finish is a minimum level. Provide the type of enclosure as indicated on the drawings.
2. The exterior of the enclosure shall be phosphatized, then finished in baked enamel inside and outside. Except stainless steel enclosures, which shall not be coated.
3. Inner panel shall be finished in white baked enamel.
4. All cutouts shall be painted so that no raw metal is unprotected.
5. Color chosen at time of approval of submittal.
6. After final installation, any damage to the paint finish shall be retouched.
7. Approved manufacturer:
   a. Hoffman.
   b. Engineer approved equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and as indicated on plans.

B. Units shall be installed by well qualified and experienced technicians.

C. Units shall be properly interfaced with the input and output devices.

D. Include all required-related items for a complete installation.

E. Contractor shall be responsible for compatibility of manufacturer's shop coating and final finish.

F. Support and anchor all units as per the manufacturer's recommendations and as indicated on drawings.

G. Control panels shall be provided with an Underwriters Laboratories (UL) label certifying that the panels meet UL Rule 508 requirements and 913 when applicable. All work shall be in accordance with the National Electric Code and NEMA standards.

H. Repeat factory testing after field installation with field end elements. A minimum of one day of field inspection and testing by the manufacturer shall be provided. Field inspection and testing reports shall be provided to the Engineer.

END OF SECTION 25 1316

SECTION 26 0500
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Division 26.

B. The general provisions of this Section apply to the other Division 26 sections.

C. The work shall include the furnishing of systems, equipment and materials specified in this Division and as called for on the plans, to include: supervision, operation, methods and labor for the fabrication, installation, startup and tests for the complete electrical installation.

D. Drawings for the Work are diagrammatic, intended to convey the scope of the Work and to indicate the general arrangement and locations of the Work. Because of the scale of the plans, certain basic items such as connectors, fittings, access panels, pullboxes, etc. are not necessarily shown. Where such items are required for proper installation of the Work, such items shall be included.

E. Equipment specifications may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.

F. Where noted on the plans or where called for in other sections of the Specifications the Contractor shall install equipment under this Contract and shall make required electrical connections. Contractor shall verify with the supplier of the equipment the requirements for the installation.

1.02 CONTRACTING AUTHORITY FURNISHED PRODUCTS

A. Products furnished to the site and paid for by Contracting Authority shall be as noted on plans.

1.03 CONTINUITY OF SERVICE

A. Coordinate Work to accommodate Contracting Authority's occupancy requirements during the construction period. Refer to Section 01 1000 - Summary for additional requirements.

1.04 ACTIVE SERVICES

A. Existing active services: water, gas, sewer, electric, when encountered, shall be protected against damage. Do not prevent or disturb operation of active services which are to remain. If active services are encountered which require relocation, make request to authorities having jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the Utility or Municipality having jurisdiction.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Submittal data for electrical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment, to include power requirements (wattage, voltage, amperage, power factor, etc.) dimensions, wiring diagrams, performance curves, ratings, (electrical, environmental, etc.), control sequences and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted for equipment and materials as directed in individual sections.

C. Proposed Products List: Include Products specified in all Sections.

D. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

E. Mark dimensions and values in units to match those specified.

F. The Engineer will review shop drawings to aid in interpreting the contract documents, and will in so doing assume that the shop drawings conform to all specified requirements set forth in the contract documents. The review of the shop drawing by the Engineer does not relieve the Contractor of the responsibility of complying with all elements of the contract documents.

1.06 REGULATORY REQUIREMENTS

A. Imposed Standards/Regulations:

1. General: Applicable provisions of the following codes and standards are hereby imposed on a general basis for the electrical work in addition to specific applications specified by individual work sections of the Specifications.
   a. Underwriters Laboratories (UL).
   b. NFPA 70: National Electrical Code (NEC).
   c. NFPA Standards and Pamphlets.
   d. Local and State Electrical, Mechanical and Building Codes as they apply.
   e. American Gas Association (AGA).
   f. AWS Standards for Welding.
2. Every installation shall also comply with applicable Divisions and Sections of this Specification. If changes are required to attain compliance, the Contractor shall submit the proposed changes to the Engineer for review and approval. If approval for the change is obtained, revised submittal data shall be provided for review.
3. Installations must be safe in every respect, and must not create any condition which will be harmful to building occupants, operating personnel, installation personnel, testing personnel, construction workers, and general public. If Contractor believes that the installation will not be safe for all parties, the Contractor shall so report in writing to the Engineer, stating the issues and conditions and possible remedies, before any equipment is purchased or installed.
4. The manufacturer of each type of equipment, used by itself or as a part of any system, shall carefully check capacities, arrangements, and methods shown or specified (including space requirements, servicing requirements, ambient air temperatures, etc.) for installation of the equipment, and all connections to other system or to parts of same system to assure that when used, connected, interconnected, piped, wired, or controlled as specified, the equipment can be properly serviced. If the manufacturer has any reservations in this regard, the manufacturer shall state such reservations and any suggested changes to the Engineer as a part of the shop drawing submission.
5. Engineer will work out required changes and adjustments in Contract Prices where such adjustments are warranted. No adjustments in Contract Price will be allowed for additions required by applicable code, ordinance, statute, utility regulation, or labor regulation. It is the obligation of the Contractor to include such items in the original Bid. Changes in equipment shall be incorporated in shop drawings. If Contractor fails to call such reservations or suggestions to Engineer's attention, in writing, before any work is done or equipment is purchased, it will be assumed that the Contractor accepts responsibility for providing a completely safe and completely coordinated installation. If at a later date changes become necessary to assure a completely safe and coordinated installation, they shall be made, as approved by Engineer, without increase in Contract Price.

B. Permits and Tests, Electrical Work: Unless otherwise noted in the detailed contractual description preceding these technical specifications, the Contractor shall secure all permits and pay all fees required in connection with this installation and shall be responsible for securing such inspections as are required by the authorities with jurisdiction over the site. Submit a record copy to the Contracting Authority and the Engineer of electrical work notices, permits, licenses, inspection or test reports, and similar items obtained in response to governing and imposed regulations and standards.

1.07 PROJECT CONDITIONS

A. Inspect site prior to bidding to be thoroughly familiar with existing conditions.

B. Install Work in locations shown on Drawings, unless prevented by Project conditions.

C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

D. All Contractors shall familiarize themselves with the site and with any conditions of the site and/or existing buildings which might present unusual aspects to the work involved. Contractor shall verify all aspects of electrical work, insofar as is possible, check routes of conduit indicated, verifying clearances and other obstacles which might influence the construction proposed. No extras can be allowed on work occasioned by the Contractor's failure to make this inspection.

1.08 SEQUENCING AND SCHEDULING

A. Install work to accommodate Contracting Authority's occupancy requirements during construction period and coordinate electrical schedule and operations with Contracting Authority.

B. Construct Work in sequence under provisions of Division 1 - General Requirements and other Sections as applicable.

C. Completion of Electrical Work shall be coordinated with other trades and contractors to expedite completion of the Project.

D. The Contractor shall coordinate the placing of openings in the structures as required for the installation of the Electrical Work.

E. It will be the Contractor's responsibility to examine the contract documents, to take measurements where required, to verify dimensions for correct placement of equipment and to progress the Contract as expeditiously as possible, so that the progress of the work is orderly and does not cause unnecessary cutting and patching of the structure. The Contractor shall be pecuniarily responsible for the cutting and patching of the structure occasioned by failure to install sleeves, grilles or other items required by the Electrical Work at the proper time for the normal installation of such items.

F. The Contractor shall provide cutting and patching and patch painting of the structure, as required for the installation of the Work, and shall furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Engineer. Extent of cutting shall be minimized; use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

G. The determination of quantities of material and equipment required shall be made by the Contractor from the contract documents. Schedules on the contract documents are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

1.09 OPENINGS, CUTTING, AND PATCHING

A. The Contractor shall coordinate the placing of openings in structures, as required, for the installation of the Electrical Work.

B. The Contractor shall coordinate the accurate locations and sizes for required openings, and shall have the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to the Contractor's failure to inspect the work, then the Contractor shall make arrangements for the patching required to properly close the openings, to include patch painting, and the Contractor shall pay any additional cost incurred in this respect.

C. When cutting and patching of the structure is made necessary due to the Contractor's failure to install conduit wiring or equipment on schedule, or due to the Contractor's failure to furnish, on schedule, the information required for the leaving of openings, then it shall be the Contractor's responsibility to make arrangements for the cutting and patching and the Contractor shall pay any additional cost incurred in the correction.

D. The Contractor shall provide cutting, patching and patch painting as required for the installation of Work in existing structures, and shall furnish lintels and supports as required for openings.

E. Cutting of structural support members will not be permitted without prior approval of the Engineer. Extent of cutting shall be minimized; use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

1.10 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Contracting Authority's option. Accepted Alternates will be identified in Contracting Authority-Contractor Agreement.

B. Coordinate related work and modify surrounding work as required.

1.11 CONCRETE WORK

A. The Contractor shall coordinate size and location of concrete bases and pads for electrical equipment with the required trades and with the Utility.

B. The Contractor shall furnish equipment anchor bolts and shall be responsible for their proper installation and accurate location.

1.12 WIRING FOR ELECTRICAL EQUIPMENT

A. The Contractor will provide power services for motors and equipment furnished by the Mechanical Contractor to include safety disconnect switches and final connections.

B. The Contractor will be responsible for power wiring, internal wiring, alarm wiring, control wiring or interlock wiring of all equipment installed or modified under this Contract.

C. The Contractor shall review the plans and shall call to the attention of the Engineer, prior to bidding, omissions of electrical services required for this equipment.

1.13 PROTECTION

A. Special care shall be taken for the protection of equipment furnished by the Contractor. Equipment and material shall be completely protected from weather elements, painting, plaster, etc. until the Project is completed. Damage from rust, paint, scratches, etc. shall be repaired as required to restore equipment to original condition.

B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the Contractor performing that work, but this shall not relieve the Contractor of the responsibility of checking to assure that adequate protection is being provided.

C. Where the installation or connection of equipment requires the Contractor to work in areas previously finished, the Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. The Contractor shall repair and refinish such areas which were damaged due to work performed by the Contractor.

D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute weight and support such materials.

1.14 FINISHING

A. Prior to acceptance of the installation and final payment of the Contract, the Contractor shall perform the work outlined herein.

B. Perform cleaning required by Division 1 applicable to this Division of the Work. Cleaning shall include removing debris and dirt from panels, pull boxes, junction boxes, and other enclosures.

C. Operation and Maintenance Manuals: Prepare and submit Operation and Maintenance manuals as described in Division 1 and related sections in Division 26.

1.15 TEST AND DEMONSTRATIONS

A. Systems shall be tested and placed in proper working order prior to demonstrating systems to Contracting Authority.

B. Prior to acceptance of the electrical installation, the Contractor shall demonstrate to the Contracting Authority or designated representatives all essential features and functions of all systems installed, and shall instruct the Contracting Authority in the proper operation and maintenance of such systems.

C. Contractor shall furnish the necessary trained personnel to perform the demonstrations and instructions and shall arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Contracting Authority and Contractor shall each sign a certification stating that the training has been performed and the Contracting Authority accepts same.

1.16 PAINTING AND IDENTIFICATION

A. Painting of electrical enclosures (switch/outlet boxes, starters, disconnects, control cabinets and panelboards) shall be touch-up only of factory finish or finish specified elsewhere.

B. Conduit and raceway systems shall be unpainted unless specifically noted. If painting of conduit and raceway systems is required, coat with paint type and color to match background mounting surface.

C. Identify panels, switchgear, starters, switches, valves and dampers with engraved nameplates.

D. Provide typed panel and switchboard schedules.

E. Provide plastic "Buried Electrical" warning tape in trench above all underground circuit runs. Place approximately 18 inches below finished grade.

1.17 PRODUCT QUALITY, PERFORMANCE, AND SUBSTITUTIONS

A. All materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product, and where more than one unit is required of the item, all shall be of the same manufacturer.

B. Proposals as submitted shall be based on the products specifically named in the specifications.

C. If specific products of more than one manufacturer are specified, the choice of these shall be made optional with the Contractor.

D. All materials are subject to approval by the Engineer both before and after incorporation in the building.

E. Should suppliers of materials not specified wish to bid their material as a base bid equal, they shall secure the written approval of the Engineer that their product is acceptable as an equal to that specified at least 10 days in advance of the bid date to have their products covered in an Addendum prior to opening of bids.

F. The Engineer reserves the right to refuse approval on equipment which does not meet the specification. Any materials not conforming to the specification may be ordered removed any time during the course of construction, and the Contractor shall replace such items, when notified, at the Contractor's expense. The Engineer further reserves the right to reject equipment for which the availability of maintenance service and replacement parts is questionable.

G. All materials and equipment shall be new. Second-hand, used, or salvaged equipment will not be allowed unless specifically noted.

H. All elements of the construction shall be performed by workmen skilled in the particular craft involved, and regularly employed in that particular craft. All work shall be performed in a neat, workmanlike manner in keeping with the highest standards of the craft.

I. The Engineer reserves the right to determine space priority of the equipment in the event of interference between the piping and equipment of the various installations. Conflicts between the Drawings and Specifications, or between requirements set forth for the various trades shall be called to the attention of the Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required and that the Contractor has submitted the bid in conformance with Contract Documents as issued.

1.18 EXCAVATING, TRENCHING AND BACKFILLING

A. The Contractor shall do excavating necessary for underground electrical ducts, wiring, manholes, conduit, etc., and shall backfill such trenches and excavations after equipment has been installed and tested. Care shall be taken in excavating, that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing. Where a line must pass under footing, the crossing shall be made by the smallest possible trench to accommodate the pipe.

B. Excavation shall be kept free from water by pumping if necessary. No greater length of trench shall be left open, in advance of pipe and utility laying, than necessary.

C. Immediately after testing and/or inspection, the trench shall be carefully backfilled. Place backfill into trench so the impact on installed pipe is minimized. Backfill and compact to specifications for utility trenching.

1.19 COORDINATION

A. Where the Contract Documents state that equipment shall be "furnished", "installed", or "provided", it shall be understood to mean the Contractor shall furnish and install completely unless otherwise noted.

1.20 EXISTING SERVICE

A. If existing services are encountered in the Work, protect, brace, and support existing active sewers, gas, electric, or other services where required for the proper execution of the Work. If existing active services are encountered that require relocation, make request to proper authorities for determination of procedure. Do not prevent or disturb operation of active services that are to remain.

1.21 TEMPORARY SHUTDOWNS OR ABANDONED SERVICES

A. Where the Work makes temporary shutdowns or need to abandon unavoidable, Contractor shall consult with the Contracting Authority as to times and procedures for such shutdowns. Where existing services are to be abandoned, wiring shall be removed and conduit shall be properly capped in conformance with requirements of the Utility.

1.22 SITE

A. The site shall be kept orderly and clean at all times during the construction and the storing of materials shall be in accordance with the requirements of the Contracting Authority in areas designated for that purpose. At the conclusion of the construction, the site shall be cleaned thoroughly of all rubble, debris and unused materials and shall be left in good order. All tunnels, chases or closed off spaces shall be cleaned of all waste materials, wood frame members, etc. used in construction.

1.23 NOISE AND VIBRATION

A. Electrical equipment shall operate without objectionable noise or vibration as determined by the Engineer. If such objectionable noise or vibration should be produced and transmitted to occupied portions of the building by apparatus, conduit, ducts or other parts of the electrical work, the Contractor shall make necessary changes and additions, as approved by the Engineer.

1.24 EQUIPMENT INSTALLATION

A. Erect equipment in neat and workmanlike manner, align, level and adjust for satisfactory operation, install so that connecting and disconnecting parts can be made readily and so that all parts are easily accessible for inspection, operation and maintenance.

1.25 APPLICATIONS

A. Where applications are required for the procuring of utility service to the building, the Contractor shall see that such application is properly filed with the Utility and that all information required for such an application is presented to the extent and in the form required by the Utility Company.

1.26 RECORD UTILITIES DRAWINGS

A. Contractor shall prepare and submit to Engineer drawings showing the exact location of all installed underground electrical and conduit runs and any existing underground utilities encountered during installation. The drawings shall give accurate locations (referenced to visible above-grade objects) and dimensions of all such equipment for future use by the Contracting Authority. These drawings shall be submitted to the Engineer as soon as practicable after such runs have been installed.

END OF SECTION 26 0500

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Wire and cable for 600 volts and less.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Oxide inhibiting compound.

G. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ASTM B 3 - Standard Specification for Soft or Annealed Copper Wire.

B. ASTM B 8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. ASTM B 33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B 787/B 787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.

E. ASTM B 800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers.

F. ASTM B 801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation.

G. ASTM D 3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

H. ASTM D 4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.

I. NECA 1 - Standard for Good Workmanship in Electrical Construction.

J. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

K. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

L. NFPA 70 - National Electrical Code.

M. UL 44 - Thermoset-Insulated Wires and Cables.

N. UL 83 - Thermoplastic-Insulated Wires and Cables.

O. UL 486A-486B - Wire Connectors.

P. UL 486C - Splicing Wire Connectors.

Q. UL 486D - Sealed Wire Connector Systems.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Engineer of any conflicts with or deviations from contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Field Quality Control Test Reports.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

E. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 °F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

B. Perform Work in accordance with NECA Standard of Installation.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Alan Wire Company

B. Belden, Inc.

C. Cablec.

D. Carroll.

E. Southwire Company.

F. Triangle.

G. Engineer approved equivalent.

2.02 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is not permitted.

H. Manufactured wiring systems are not permitted.

I. All conductors/circuits shall be copper conductor. Use of aluminum conductors shall not be allowed unless specifically noted.

J. All circuits shall be installed as building wire, control wire, or signal cable in raceway unless specifically noted or indicated on the Drawings.

K. Use conductor not smaller than 12 AWG for power and lighting circuits.

L. Use conductor not smaller than 14 AWG for control circuits.

2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

H. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

I. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 % conductivity, uncoated copper conductors complying with ASTM B 3, ASTM B 8, or ASTM B 787/B 787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B 33.

J. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

K. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:

a. 480Y/277 V, 3 Phase, 4 Wire System:
    1) Phase A: Brown.
    2) Phase B: Orange.
    3) Phase C: Yellow.
    4) Neutral/Grounded: Gray.
b. 208Y/120 V, 3 Phase, 4 Wire System:
    1) Phase A: Black.
    2) Phase B: Red.
    3) Phase C: Blue.
    4) Neutral/Grounded: White.
c. Equipment Ground, All Systems: Green.
d. Isolated Ground, All Systems: Green with yellow stripe.
e. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE

A. Conductor Stranding:
1. Feeders and Branch Circuits:
    a. Size 10 AWG and Smaller: Solid.
    b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

B. Insulation Voltage Rating: 600 V.

C. Insulation:
1. Copper Building Wire: Type XHHW-2.

D. Conductor: Stranded Copper.

2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
4. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Ilsco: www.ilsco.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.

G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Ilsco: www.ilsco.com/#sle.

c. Thomas & Betts Corporation: www.tnb.com/#sle.

H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.

2.06 ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 °F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 °F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 °F and short-term 266 °F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 °F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 °F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Burndy LLC: www.burndy.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. Ilsco: www.ilsco.com/#sle.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. American Polywater Corporation: www.polywater.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.

E. Cable Ties: Material and tensile strength rating suitable for application.

2.07 CONTROL AND SIGNAL CABLE

A. Cable for Discrete Control Signals:
1. Single conductor, 14 AWG stranded copper, type THHN/THWN insulation.

B. Signal Cable for Analog Control Signals:
1. Plan Mark TSP: One twisted shielded pair 18 AWG, 300V - Belden 8760 or equal.

2. Plan Mark TST: One twisted shielded triad (3-conductors), 18 AWG, 300V - Belden 8770 or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that raceway installation is complete and supported.

E. Verify that field measurements are as indicated.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Verify conduit systems are ready to accept cables.

B. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
4. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Exposed Cable Installation (only where specifically permitted):
1. Route cables parallel or perpendicular to building structural members and surfaces.
2. Protect cables from physical damage.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

H. Install conductors with a minimum of 12 inches of slack at each outlet.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

K. Make wiring connections using specified wiring connectors.
    1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
    2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
    3. Do not remove conductor strands to facilitate insertion into connector.
    4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
    5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
    6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
    1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
        b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
    2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
        b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
    3. Wet Locations: Use heat shrink tubing.

M. Insulate ends of spare conductors using vinyl insulating electrical tape.

N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

O. Identify conductors and cables in accordance with Section 26 0553.

P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

Q. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

R. All interconnecting circuit wires or cables (power and control) shall be tagged with an appropriate numbering system that assigns a unique identification to the wire or cable that is compatible with the tagging system of the connected equipment. Tags shall be applied at all junctions and terminations of each wire or cable.

S. Install a waterproof sealant (such as silicone rubber) in conduits connected to control valves, instrumentation, and other electrical power and control devices mounted directly to water piping. Inject sealant near end of flexible conduit connected to device. Install sealant after all power and control conductors have been installed and operation of equipment has been verified.

T. Conductors shall be terminated on screw or compression lug terminals. Conductor runs shall not be spliced between points of termination unless specified or approved by the Engineer.

U. Route wire and cable as required to meet project conditions.

V. Pull all conductors into raceway at same time.

W. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

X. Neatly train and lace wiring inside boxes, equipment, and panelboards.

Y. Clean conductor surfaces before installing lugs and connectors.

Z. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

AA. Terminate spare conductors with electrical tape and label as such.

BB. Use split bolt connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 % of insulation rating of conductor.

CC. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 0519

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground rod electrodes.

E. Wire, components, and miscellaneous equipment in supplying and installing electrical grounding systems.

F. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Metal underground water pipe.
   2. Ground rings.
   3. Rod electrodes.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 467 - Grounding and Bonding Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

1.06 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Test Reports: Indicate overall resistance to ground .

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.07 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Material and components shall be inspected for damage and physical defects.

B. Material and components shall be stored in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in PVC SCH80 raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Ground Ring:
      a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
      b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
      c. Provide connection from ground ring conductor to:
         1) Ground rod electrodes located as indicated.
   3. Ground Rod Electrode(s):
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet from each other and any other ground electrode.
      c. Provide ground access well for first connected electrode.
   4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

F. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare tinned copper conductors where installed underground in direct contact with earth.
      2) Use bare tinned copper conductors where installed in corrosive environments.
      3) Use bare copper conductors where directly encased in concrete (not in raceway).
      4) Use bare copper conductors where installed in PVC conduit or PVC-Coated GRC .

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors or compression connectors for accessible connections.
4. Manufacturers - Mechanical and Compression Connectors:
   a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
   b. Burndy LLC: www.burndy.com/#sle.
   c. Thomas & Betts Corporation: www.tnb.com/#sle.
5. Manufacturers - Exothermic Welded Connections:
   a. Burndy LLC: www.burndy.com/#sle.
   b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
   c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

D. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
   4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
   5. Manufacturers:
      a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. Harger Lightning & Grounding: www.harger.com/#sle.

E. Oxide Inhibiting Compound: Comply with Section 26 0519.

2.03 CONDUCTORS/WIRE

A. Material: Copper.

B. Grounding electrode conductors and bonding jumpers:
   1. Sizes 8 AWG and smaller: Bare solid conductor.
   2. Sizes 6 AWG and larger: Bare stranded conductor.

C. Equipment grounding conductors:
   1. Stranded, insulated.

D. Size conductors as indicated on the plans. If no size is indicated, size conductors to meet NFPA 70 requirements.

2.04 CONNECTORS AND ACCESSORIES

A. Compression Crimp Connectors: Copper.

B. Mechanical Connectors: Bronze.

C. Exothermic Connectors: Exothermic charges and molds as required for various configurations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

E. Verify final length and location of ground conductors.

F. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches deep in accordance with NFPA 70.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

F. Install Products in accordance with manufacturer's instructions.

G. Provide bonding to meet requirements described in Quality Assurance.

H. Equipment Grounding Conductor: Provide an equipment grounding conductor with each feeder and branch circuit regardless of raceway type. Terminate each end on suitable lug, bus, or bushing.

I. Concealed connections such as those underground or buried inside inaccessible wall or ceiling spaces shall be compression crimp or exothermic type. Mechanical connections shall be for exposed or readily accessible connections only.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 0526

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

B. Conduit and equipment supports.

C. Anchors and fasteners.

1.02 RELATED REQUIREMENTS

A. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

B. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NFPA 70 - National Electrical Code.

C. UL 5B - Strut-Type Channel Raceways and Fittings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
3. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
4. Notify Engineer of any conflicts with or deviations from contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems and post-installed concrete and masonry anchors.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 DESCRIPTION

A. Description: Steel channel, fittings, and anchors used to support various electrical devices and equipment racks.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Materials and components shall be inspected for damage and physical defects.

B. Materials and components shall be stored in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel or approved equivalent unless otherwise indicated.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.

1. Conduit Clamps: Bolted type unless otherwise indicated.
2. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Erico International Corporation: www.erico.com/#sle.
    c. O-Z/Gedney, a brand of Emerson Electric Co; www.emerson.com/#sle.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

1. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Erico International Corporation: www.erico.com/#sle.
    c. O-Z/Gedney, a brand of Emerson Electric Co; www.emerson.com/#sle.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

1. Channel Material:
    a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel.
2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
3. Minimum Channel Dimensions: 1 5/8 inch width by 13/16 inch height.
4. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Thomas & Betts Corporation: www.tnb.com/#sle.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.

E. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use expansion anchors or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

4. Steel: Use beam clamps, machine bolts, or welded threaded studs.
5. Plastic and lead anchors are not permitted.
6. Powder-actuated fasteners are not permitted.
7. Hammer-driven anchors and fasteners are not permitted.
8. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
9. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Engineer, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Engineer.

H. Equipment Support and Attachment:
    1. Use supports assembled from metal channel (strut) to support equipment as required.
    2. In wet and damp locations use stainless steel channel supports to stand cabinets, conduits, and panelboards 1/4 inch off wall.
    3. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Conduit Support and Attachment: Also comply with Section 26 0533.13.

J. Box Support and Attachment: Also comply with Section 26 0533.16.

K. Secure fasteners according to manufacturer's recommended torque settings.

L. Install surface-mounted cabinets and panelboards with minimum of four anchors.

M. In wet and damp locations use stainless steel channel supports to stand cabinets and panelboards 1/4 inch off wall.

3.03 FIELD QUALITY ASSURANCE

A. Verify all supports are securely anchored and fastened.

B. Verify all supports are level and square.

END OF SECTION 26 0529

SECTION 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. PVC-coated galvanized steel rigid metal conduit (RMC).

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Rigid polyvinyl chloride (PVC) conduit.

F. Conduit fittings.

G. Accessories.

H. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0533.16 - Boxes for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A).

C. ETL PVC-001 - Adhesion Performance for Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.

G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

H. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

I. NFPA 70 - National Electrical Code.

J. UL 1 - Flexible Metal Conduit.

K. UL 6 - Electrical Rigid Metal Conduit-Steel.

L. UL 360 - Liquid-Tight Flexible Metal Conduit.

M. UL 514B - Conduit, Tubing, and Cable Fittings.

N. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

O. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

P. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Notify Engineer of any conflicts with or deviations from contract documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
1. Under Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
2. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit.
3. Where rigid PVC conduit is provided, transition to PVC-coated galvanized steel rigid metal conduit where emerging from underground.

D. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
2. Within Slab Above Ground: Not permitted.

E. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.

F. Exposed, Exterior: Use galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit.

G. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.

H. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit.

I. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.02 CONDUIT REQUIREMENTS

A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
   2. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
   3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      b. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use steel or malleable iron.
   5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Perma-Cote: www.permacote.com.
   2. Atkore; Calbond: www.calbond.com.
   3. Thomas & Betts Corporation: www.tnb.com/#sle.
   4. Engineer approved equivalent.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6 and ETL PVC-001.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. Interior Coating: Urethane, minimum thickness of 2 mil.

E. PVC-Coated Fittings:
   1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
   2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B. Conduit bodies shall also comply with UL Type 4X and IEC IP69.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.

4. Material: Use steel or malleable iron.
5. Exterior Coating: PVC, minimum thickness of 40 mil.
6. Interior Coating: Urethane, minimum thickness of 2 mil.

F. PVC-Coated Supports: Furnish with exterior coating of PVC, minimum thickness of 15 mil.

G. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.

H. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.05 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. Anamet Inc.
3. Electri-Flex Company.
4. Engineer approved equivalent.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

D. Description: Interlocked aluminum construction.

E. Fittings: NEMA FB 1.

2.06 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. Electri-Flex Company.
3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
1. Manufacturers:
   a. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
   b. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction with PVC jacket.

E. Fittings: NEMA FB 1.

2.07 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Cantex: https: //www.cantexinc.com/.
2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
3. AFC Cable Systems, Inc: www.afcweb.com.
4. Allied: https://www.alliedeg.us/pvc/rigid-conduit/.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 °C.

C. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

D. Rigid Plastic Conduit:
1. Description: NEMA TC 2; Schedule 80 PVC.
2. Fittings and Conduit Bodies: NEMA TC 3.

2.08 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface is ready for conduit installation.

B. Examine conduit to verify that it is free from damage.

C. Examine conduit to verify it is free of foreign objects.

D. Verify that field measurements are as indicated.

E. Verify that mounting surfaces are ready to receive conduits.

F. Verify that conditions are satisfactory for installation prior to starting work.

G. Verify routing and termination locations of conduit prior to rough-in.

H. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel RMC in accordance with NECA 101.

D. Install PVC-coated galvanized steel RMC using only tools approved by the manufacturer. Those installing PVC-coated galvanized steel rigid metal conduit shall be certified by the manufacturer and be able to provide a valid, unexpired Installer Certification card prior to installation beginning.

E. Install rigid PVC conduit in accordance with NECA 111.

F. Conduit Routing:
1. When conduit destination is indicated without specific routing, determine exact routing required.
2. Arrange conduit to maintain adequate headroom, clearances, and access.
3. Arrange conduit to provide no more than the equivalent of three 90 degree bends between pull points.
4. Arrange conduit to provide no more than 150 feet between pull points.
5. Route conduits above water and drain piping where possible.
6. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

7. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
8. Maintain minimum clearance of 12 inches between conduits and hot surfaces.

G. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
4. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
5. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
6. Use of spring steel conduit clips for support of conduits is not permitted.
7. Use of wire for support of conduits is not permitted.
8. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

J. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid PVC conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

L. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

M. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

N. Provide grounding and bonding in accordance with Section 26 0526.

O. Identify conduits in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Where coating of PVC-coated galvanized steel RMC contains cuts or abrasions, repair in accordance with manufacturer's instructions with a manufacturer approved touch-up compound or repair kit.

C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

B. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.

C. Install steel conduit as specified in NECA 101.

D. Install no more than equivalent of four 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch size.

3.06 INTERFACE WITH OTHER PRODUCTS

A. All penetrations of corridor walls and rated fire and smoke walls shall be conduit. All penetrations shall be filled with fire stopping material.

END OF SECTION 26 0533.13

SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Pull and junction boxes.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NFPA 70 - National Electrical Code.

H. UL 514A - Metallic Outlet Boxes.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Notify Engineer of any conflicts with or deviations from contract documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for junction and pull boxes and cabinets and enclosures.

C. Project Record Documents: Record actual locations for junction boxes, pull boxes, and cabinets and enclosures.

D. Maintenance Materials: Furnish the following for Contracting Authority's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Keys for Lockable Enclosures: Two of each different key.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

B. Comply with requirements of NFPA 70.

C. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store boxes in a dry location.

B. Store in such a manner that the boxes will not be damaged.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
4. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   a. Indoor Clean, Dry Locations: Type 1, painted steel.
   b. Outdoor Locations: Type 4X, stainless steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
   a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
   b. Back Panels: Painted steel, removable.
   c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 % spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Examine prints for locations of all outlets.

E. Verify rooms and walls are ready to accept boxes.

F. Verify field measurements are as shown on plans.

G. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

E. Install boxes plumb and level.

F. Close unused box openings.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

I. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
   1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

J. Maintain headroom and present neat mechanical appearance.

K. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

L. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.
   1. Provide pull boxes where indicated on plans or required to facilitate the installation of the conduit and wire.
   2. Pull box construction, in general, shall be NEMA 1 unless noted otherwise on the drawings.
   3. Pull boxes shall be located in unfinished areas unless specifically permitted on the drawings.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

END OF SECTION 26 0533.16

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Warning signs and labels.

1.02 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. UL 969 - Marking and Labeling Systems.

1.03 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    a. Enclosed switches, circuit breakers, and motor controllers:
        1) Identify voltage and phase.
        2) Identify power source and circuit number. Include location when not within sight of equipment.
        3) Identify load(s) served. Include location when not within sight of equipment.
2. Service Equipment:
    a. Use identification nameplate to identify each service disconnecting means.
3. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
4. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.

a. Service equipment.
b. Industrial control panels.
c. Industrial machinery.

5. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. At each source and load connection.
   b. Within boxes when more than one circuit is present.
   c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

C. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

2.02 MANUFACTURERS

A. Brady Corp.

B. Seton Identification Products.

C. HellermannTyton.

D. Engineer approved equivalent.

2.03 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use stainless steel nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. Equipment Designation: 1/2 inch.
5. Color:
   a. Normal Power System: White text on black background.

D. Format for General Information and Operating Instructions:
   1. Minimum Size: 1 inch by 2.5 inches.
   2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height: 1/4 inch.
   5. Color: Black text on white background unless otherwise indicated.

E. Format for Control Device Identification:
   1. Minimum Size: 3/8 inch by 1.5 inches.
   2. Legend: Load controlled or other designation indicated.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height: 3/16 inch.
   5. Color: Black text on clear background.

F. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

G. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Communication cabinets.

H. Letter Size:
   1. Use 1/8 inch letters for identifying individual equipment and loads.
   2. Use 1/4 inch letters for identifying grouped equipment and loads.

I. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, and control device stations.

2.04 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

G. Description: split sleeve type wire markers.

H. Locations: Each conductor at motor control centers, control panels, panelboard gutters, pull boxes, and junction boxes at each load connection.

I. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on shop drawings.

2.05 VOLTAGE MARKERS

A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

B. Minimum Size:
   1. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   2. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

C. Legend:
   1. Markers for Voltage Identification: Highest voltage present.

D. Color: Black text on orange background unless otherwise indicated.

E. Description: Tape.

F. Location: Furnish markers for each conduit longer than 6 feet.

2.06 UNDERGROUND WARNING TAPE

A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
   1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Contracting Authority.

B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.

C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.07 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

C. Description: 3 inch wide polyethylene tape, detectable type colored red with suitable warning legend describing buried electrical lines.

D. Description: 4 inch wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Interior Components: Legible from the point of access.
   6. Boxes: Outside face of cover.
   7. Conductors and Cables: Legible from the point of access.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION 26 0553

SECTION 26 0573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.

F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations.

G. NEMA MG 1 - Motors and Generators.

H. NFPA 70 - National Electrical Code.

I. NFPA 70E - Standard for Electrical Safety in the Workplace.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify Engineer of any conflicts with or deviations from contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Engineer.

1.04 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Study reports, stamped or sealed and signed by study preparer.

C. Site-specific arc flash hazard warning labels.

D. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

E. Project Record Documents: Revise studies as required to reflect as-built conditions.
   1. Include hard copies with operation and maintenance data submittals.
   2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.05 POWER SYSTEM STUDIES

A. Scope of Studies:
   1. Perform analysis of new electrical distribution system as indicated on drawings.

2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).

B. General Study Requirements:
1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
   a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      1) Obtain up-to-date information from Utility Company.
      2) Utility Company: MidAmerican Energy.
         (a) Point of Contact: Jordan Hohensee.
         (b) Phone: 515-242-4235.
         (c) Email: jordan.hohensee@midamerican.com.
   b. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
   c. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
   d. Protective Devices:
      1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
      2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
   e. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
   a. Maximum utility fault currents.
   b. Maximum motor contribution.
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
   a. Maximum and minimum utility fault currents.

b. Maximum and minimum motor contribution.

G. Study Reports:
1. General Requirements:
   a. Identify date of study and study preparer.
   b. Identify study methodology and software product(s) used.
   c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
   d. Identify base used for per unit values.
   e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
   f. Include conclusions and recommendations.
2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):
      1) Partial single-line diagram identifying the portion of the system illustrated.
      2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
      3) Conductors: Damage curves.
      4) Transformers: Inrush points and damage curves.
      5) Motors: Full load current, starting curves, and damage curves.
   c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
      1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
      2) Include ground fault pickup and delay.
      3) Include fuse ratings.
      4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
   d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
   a. For the worst case for each scenario, identify at each bus location:
      1) Calculated incident energy and associated working distance.
      2) Calculated arc flash boundary.
      3) Bolted fault current.
      4) Arcing fault current.
      5) Clearing time.
      6) Arc gap distance.
   b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.06 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State of Iowa and with minimum 5 years experience in the preparation of studies of similar type and complexity using specified computer software.
   1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.

B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
   1. Acceptable Software Products:
      a. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
   1. Materials: Comply with Section 26 0553.
   2. Minimum Size: 4 by 6 inches.
   3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
      a. Include the following information:
         1) Arc flash boundary.
         2) Available incident energy and corresponding working distance.
         3) Site-specific PPE (personnel protective equipment) requirements.
         4) Nominal system voltage.
         5) Equipment identification.
         6) Date calculations were performed.

PART 3 EXECUTION

3.01 INSTALLATION

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Adjust equipment and protective devices for compliance with studies and recommended settings.

C. Notify Engineer of any conflicts with or deviations from studies. Obtain direction before proceeding.

3.03 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION 26 0573

SECTION 26 2100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical service requirements.

1.02 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.03 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NFPA 70 - National Electrical Code.

1.04 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Engineer of any conflicts with or deviations from contract documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Contracting Authority.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
   1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.

D. Project Record Documents: Record actual locations of equipment and installed service routing.

1.06 QUALITY ASSURANCE

A. Comply with the following:

1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: MIdAmerican Energy.
1. Point of Contact: Jordan Hohensee.
2. Phone: 515-242-4235.
3. Email: Jordan.Hohensee@midamerican.com.

D. Division of Responsibility:
1. Pad-Mounted Utility Transformers:
   a. Transformer Pads: Furnished and installed by Contractor per Utility Company requirements.
   b. Transformers: Furnished and installed by Utility Company.
   c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
   d. Transformer Protective Bollards: Furnished and installed by Contractor per Utility Company requirements.
   e. Primary:
      1) Trenching and Backfilling: Provided by Contractor.
      2) Conduits: Furnished and installed by Contractor.
      3) Conductors: Furnished and installed by Utility Company.
   f. Secondary:
      1) Trenching and Backfilling: Provided by Contractor.
      2) Conduits: Furnished and installed by Contractor.
      3) Conductors: Furnished and installed by Contractor (Service Point at transformer).
2. Terminations at Service Point: Provided by Utility Company.
3. Metering Provisions:
   a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment components in accordance with Section 26 0529.

E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.

F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

END OF SECTION 26 2100

SECTION 26 2816.13
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed main circuit breaker.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

I. UL 869A - Reference Standard for Service Equipment.

1.04 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of circuit breaker.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Record actual locations of Products; indicate actual branch circuit arrangement.

H. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain one copy of each document on site.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Metallic components shall be inspected for damage and physical defects.

B. Metallic components shall be stored in accordance with manufacturer's recommendations.

1.08 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer/Eaton Corporation.

B. Square D Company.

C. Engineer approved equivalent.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6600 feet.
   2. Ambient Temperature: Between 23 °F and 104 °F.

D. Short Circuit Current Rating:
   1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Provide electronic trip circuit breakers where indicated.

H. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

I. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Outdoor Locations: NEMA 4X Stainless Steel.
   2. Provide surface-mounted enclosures unless otherwise indicated.

K. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity:
   1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating as determined by the short circuit study performed in accordance with Section 26 0573
   2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:
   1. Provide mechanical lugs unless otherwise indicated.
   2. Lug Material: Copper, suitable for terminating copper conductors only.

D. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   1. Provide the following field-adjustable trip response settings:
      a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      b. Long time delay.
      c. Short time pickup and delay.
      d. Instantaneous pickup.

E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

F. 600V rating. Provide circuit breaker with current rating as listed on the plans.

2.04 TRIP UNITS

A. Solid-State Circuit Breaker: Provide circuit breaker with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip.

2.05 ACCESSORIES

A. Handle Lock: Include provisions for padlocking.

B. Provide insulated grounding lug.

C. Provide products suitable for use as service entrance equipment where so applied.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed circuit breakers plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

I. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

J. Identify enclosed circuit breakers in accordance with Section 26 0553.

K. Install enclosed circuit breakers using spacers to stand enclosure a minimum of 1/8 inch from wall or mounting surface.

L. Provide arc flash warning labels in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than 50 amperes. Tests listed as optional are not required.

1. Perform insulation-resistance tests on all control wiring with respect to ground.
2. Test functions of the trip unit by means of secondary injection.

D. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

E. Perform field inspection and testing in accordance with Section 01 4000.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

END OF SECTION 26 2816.13

SECTION 26 2816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

B. Nonfusible switches.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA AB 1 - Molded Case Circuit Breakers.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

E. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

F. NFPA 70 - National Electrical Code.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

I. UL 98 - Enclosed and Dead-Front Switches.

1.03 SUBMITTALS

A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, ampacity, integrated short circuit, arrangement and size of disconnect switches.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

D. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

E. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

F. Project Record Documents: Record actual locations of enclosed switches.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect products from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

1.06 SERVICE REPRESENTATIVE

A. Manufacturer shall have service facilities or an authorized service representative within 250 miles of project.

B. Verify operation of all equipment.

C. Demonstrate operation of equipment to Engineer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer/Eaton Corporation.

B. Square D Company.

C. Engineer approved equivalent.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6600 feet.
   2. Ambient Temperature: Between -22 °F and 104 °F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

M. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Lug Material: Copper, suitable for terminating copper conductors only.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide identification nameplate for each enclosed switch in accordance with Section 26 0553.

I. Provide arc flash warning labels in accordance with NFPA 70.

J. Install disconnects as designated on the drawings.

K. Install NEMA KS 1 type disconnects using spacers to stand enclosure a minimum of 1/8 inch from wall or mounting surface.

L. Install fuses in fusible disconnect switches.

M. Provide engraved plastic nameplates, minimum 1/2 inch lettering identifying load served

N. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.03 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.

END OF SECTION 26 2816.16

SECTION 43 2113
PACKAGED PUMP STATION INSTALLATION

PART 1 GENERAL

1.01 SCOPE

A. Provide and install one pump with control panel, pump guide rails, discharge elbow and trash basket with rail.

B. Simplex control panel and three floats provided.

1.02 SECTION INCLUDES

A. Packaged pump, float switches, and control panel.

1.03 REFERENCE STANDARDS

A. ASTM A 48 – Standard Specification for Gray Cast Iron Castings.

B. ASTM A 479 – Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.

C. NEMA MG 1 – Motors and Generators; 1998.

D. SUBMITTALS

E. See Section 013000 - Administrative Requirements, for submittal procedures.

F. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and connection point dimensions.

G. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, check valve information, shut off valve information, mixing valve information, pump information, motor information, fiberglass pump station information, top cover information, pipe information, float information, and control panel information.

H. Test Reports: Indicate results of performance testing.

I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

J. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

K. Manufacturer's Field Reports: Indicate procedures and findings.

L. Operation and Maintenance Data and Manuals according to section 017800 – Closeout Submittals.

1.04 QUALITY ASSURANCE

A. Products: Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

B. See section 014000 – Quality Control, for quality control requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept unit on site, inspect for damage.

B. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flygt Products

B. Substitutions: Approved Engineer Equivalent only.

2.02 COMPONENTS

A. Pump sized per schedule in this Section. Motors shall be equipped with high temperature and moisture sensors and 50-foot power cable.

1. Pump shall be submersible model NP3171-615LT, Hard Iron impeller, 25 hp, 3-phase, 460 V, 60 Hz.

B. Pump shall have lifting chain, cable, grip eye and rail system for removal of pumps. 2-inch SS guiderail.

C. Ten-inch Ductile Iron Discharge elbow to connect to flanged ductile iron reducer and flanged discharge piping.

D. SS guiderail, 2-inch upper and intermediate

E. Flygt Mini-CAS or equal for pump monitoring mounted in control panel.

F. Pump shall have an aluminum access hatch with fall protection by pump vendor. Flush Aluminum Cover: 1/4 inch thick aluminum, to withstand live load of 300 psf with maximum deflection of 1/150th of span; open to 90 degrees and automatically lock with stainless steel hold open arm with release handle. Halliday or equal.

G. Aluminum trash basket 8 inches(D) by 18 inches(W) by 28 inches(H) with 2-inch holes.

H. Trash basket aluminum hatch with fall protection by trash basket vendor. Flush Aluminum Cover: 1/4 inch thick aluminum, to withstand live load of 300 psf with maximum deflection of 1/150th of span; open to 90 degrees and automatically lock with stainless steel hold open arm with release handle. Halliday or equal.

I. Each pump station shall have an inverted J-shaped vent pipe.

J. All internal pump station piping shall be provided including base elbows and all required fittings for connection to discharge piping.

K. Level, Liquid, Float Switch, Standard Duty
   1. Provide minimum of three float switches. See plan sheet U.10 for installation.
   2. Intrinsically safe relays or barriers located in control panel shall protect power supply to level sensors.
   3. General:
      a. Function: measure discrete level.
      b. Type: Submerged or floating in process liquid.
      c. Parts: Float switch, connecting cable, weight, and suspension bracket with fasteners, anchors, and float cable grips.
   4. Service:
      a. Type: storm water
      b. Temperature range: 32°F to 100°F.
      c. Special conditions: hazardous location; intrinsically safe circuit required.
   5. Performance:
      a. Control differential: no less than +/-1 inch from horizontal.
      b. Not affected by float rotation.
   6. Required Features:
      a. Non-mercury mechanical switch.
      b. Displace a minimum of 25 cubic inches.
      c. Water resistant SJOW electrical cord, 18 AWG minimum conductor size.
   7. Electrical:
      a. N.O. or N.C. contacts rated @ 3 A, 240 VAC, minimum.
   8. Accessories:
      a. Stainless steel mounting bracket capable of supporting the required float switches.
      b. 15 pound anchor and stainless steel suspension kit capable of supporting the required float switches.
      c. Include mounting bracket, strain-relief, field-adjustable cable clamps for field height adjustment..
   9. Acceptable Manufacturers:
      a. Anchor Scientific, Eco-Float series.
      b. Conery, 2900 series.

c. SJE Rhombus, SignalMaster series.
d. No substitutes.

L. Pump Control Panel - CP1 (Outdoor)
1. General:
a. The control system shall be designed to operate one 25 hp submersible pump at 460 VAC power characteristics as shown on the plans.
b. The control shall function as described below.
c. The equipment listed below is a guide and does not relieve the supplier from supplying a system that will function as required.
2. Sequence of Operations:
a. Pumps shall be controlled in a Lead, Lag 1, Lag 2 operation based on demand as measured by float switches.
b. Float Operation:
1) LSHH - Wet well high level alarm.
2) LSH - Lag 2 pump start.
3) LSL - Pump stop.
c. Lift Station Alarms: Provide dry contacts for remote monitoring.
1) Lift Station Common Alarm:
(a) Pump 1 Soft Start Fault.
(b) Pump 1 Overtemp.
(c) Pump 1 Seal Fail.
2) Wet Well High Level.
3. Control Panel CP1:
a. Description/Location:
1) See plan sheet U.9 One-Line Diagram, Section 25 1316 and Division 26 for additional requirements.
2) Power: 480 VAC, 3-phase, 3-wire, kAIC rating as required for the available fault current as determined by the short circuit study specified in Section 26 0573.
3) Panel Enclosure: NEMA 4X SS, painted white, two doors (with 3-point latch and door stop, padlockable handle), single side access, free standing (size as required, minimum 72 inches(H) by 72 inches (W) by 18 inches (D)), 18-inch legs, vented skirt, with aluminum inner doors.
4) Aluminum barrier between control section and power section.
5) Enclosure Insulation - R3 minimum.
6) Element Location: Inner door - power section.
(a) 480 VAC main disconnect operator.
(b) Pump breaker operator through inner door.
(c) Heater breaker operator through inner door.
(d) Control Power Transformer with primary and secondary protection circuit breakers operators through inner door.
(e) Provide duplex GFI receptacle on or through inner door.
(f) High and Low Temp Control Thermostat on or through inner door.
7) Element Location: Inner door - control section.
(a) Power On Pilot Light (W).
(b) Pump HOA Selector Switch.
(c) Pump Soft Starter HMI.
(d) Pump Running Pilot Light (G).
(e) Pump Soft Start Fault Pilot Light (R).
(f) Pump Over Temp. Pilot Light (R).
(g) Pump Seal Fail Pilot Light (R).
(h) Pump Reset Pushbutton.
(i) Pump Run Time Meter.
(j) Wet Well High Level Alarm Pilot Light (R).

8) Element Location: Internal - power section.
   (a) Main Breaker/Disconnect: 100 A, 480 V, 3 Pole, See Div. 26 for approved manufacturers and ratings.
   (b) 480 VAC Surge Protector: UL 1449, Type 2, with appropriately sized circuit breaker disconnect.
   (c) Power Distribution Blocks, as required.
   (d) Pump Breaker: 70 A, 480 V, 3 Pole, See Div. 26 for approved manufacturers and ratings.
   (e) Pump Soft Starter: 25 HP, 480 V, Allen Bradley SMC3 or engineer approved equal.
   (f) Terminal Blocks As Required.
   (g) 480:120/240 Control Transformer with primary and secondary protection. Size as required, 2.0 KVA minimum.
   (h) Control distribution breakers as required.
   (i) Enclosure Heater - Hoffman DAH series or equal, size as required.
   (j) Enclosure Filtered Fan Cooling (NEMA 4X), size as required.
9) Element Location: Internal - control section.
   (a) 120V Panel Surge Protection.
   (b) Pump protection modules (supplied by Pump Supplier)
   (c) DC Power Supply, size as required.
   (d) IS Barriers, as required.
   (e) LED Enclosure Light and Door Switch.
   (f) Breakers, Fuses, Relays, Timers, Terminals, and Misc. as required.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer’s plant prior to shipment:
   1. Minimum 3-point hydraulic performance test.
   2. No-Leak seal integrity test.
   3. Electrical integrity test

B. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture’s authorized representative. Two days of field service shall be provided by an authorized, factory-trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer’s instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer’s Warranty. The test shall demonstrate to the satisfaction of the Contracting Authority that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

3.03 SCHEDULE & DESIGN REQUIREMENTS

A. US 169 Storm Water Pump Station

B. Quantity of Pumps – One

C. Rated Head – 14 feet

D. Capacity at rated head – 2774 gpm
   1. Operating head range – 11.7 to 14.2 feet

E. Inlet/Discharge orientation – see plans

END OF SECTION 43 2113