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Technical Specifications for
SALT CREEK ESTATES
NASHVILLE, INDIANA



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Registered Professional Engineer State of Indiana
No. PE11900824 Seal affixed

Salt Creek Estates – Water Treatment Improvements Project
May 2025

NASHVILLE, INDIANA
SALT CREEK ESTATES WATER TREATMENT PLANT IMPROVEMENTS

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and Drawing conventions.
6. Constraints.
7. Work sequence.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Salt Creek Estates Water Treatment Plant Improvements

1. Project Location: Salt Creek Estates Water Treatment Plant, 9006 E. East Court, Nashville, Indiana 47448

B. Owner: Salt Creek Estates

C. Engineer: RQAW | DCCM, 8770 North St., Suite 110, Fishers, Indiana, 46038.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:

1. A new treatment building, new rapid-mix chemical feed tank, new sedimentation basin, two (2) existing relocated and media replaced filters, new transfer pit with two (2) new transfer pumps, two (2) new high-service pumps, new backwash/sludge pit, taps to the existing watermain and the existing clearwell tank, site grading, and other improvements not specifically specified herein and on the contract drawings.
- B. The Work includes:
1. Furnishing of all labor, material, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.
 2. Sole responsibility for adequacy of equipment.
 3. Maintaining the Work area and site in a clean and acceptable manner.
 4. Maintaining existing facilities in service at all times except where specifically provided for otherwise herein.
 5. Protection of finished and unfinished Work.
 6. Repair and restoration of Work damaged during construction.
 7. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.
- C. Implied and Normally Required Work: It is the intent of these Specifications to provide the Owner with complete operable systems, subsystems and other items of Work. Any part or item of Work which is reasonably implied or normally required to make each installation satisfactorily and completely operable is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.
- D. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these Specifications will be made upon this basis.
- E. Type of Contract:
1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, Residents, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - c. Do not block or prevent entry to driveways and entrances of adjacent property owners throughout the duration of the project.
- C. Condition of Existing Buildings: Maintain portions of existing buildings at or adjacent to the site affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to normal business working hours as described in the Supplementary Conditions.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than 48 hours in advance of proposed utility interruptions.
 - 2. Obtain Engineer's written permission before proceeding with utility interruptions.

- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Engineer not less than 48 hours in advance of proposed disruptive operations.
 - 2. Obtain Engineer's written permission before proceeding with disruptive operations.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
- D. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 1. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and as scheduled on Drawings.

1.8 CONSTRAINTS

- A. The Contract Documents are intended to allow the Contractor flexibility in construction of the Work however the following constraints apply:
 - 1. The Engineer is the sole judge of when the Contractor's operations are causing interference with the Owner's daily procedures. The Engineer's orders and instructions on alleviating such interferences will be carried out without delay.
 - 2. Perform the work in strict accordance within the construction limits shown.
- B. Coordinate in advance with the Owner all interruptions to existing systems and facilities. In the event of a conflict, Contractor will reschedule his operations so that the Work will not conflict with Owner's necessary operations or maintenance.

- C. Perform connections to existing facilities or systems that interfere with the operation of existing facilities or systems as quickly as possible and with as little delay as possible.

1.9 WORK SEQUENCE

- A. Coordinate work of all subcontractors.
- B. Engineer has made an attempt at a proposed sequence of construction. Submit for acceptance a detailed sequence of construction with the construction schedule prior to the Work commencing.
- C. Suggested Sequence of Construction:
 - 1. Water Treatment Plant
 - a. Tapping of existing raw water main from the lake and installation of additional gate valve on the existing watermain side of the tapping sleeve. Close gate valve after installation.
 - b. Prioritize continuous operation of the existing Water Treatment Plant.
 - 2. Selective demolition of existing water treatment plant, flowable fill of abandoned water main from lake, and fill-in with grout valve assembly at tap from lake.
 - 3. At project completion remove all soil erosion and sediment controls.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 STARTING WORK

- A. Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION 01 10 00

(NO TEXT FOR THIS PAGE)

SECTION 01 20 00 - CONTRACT ITEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Section includes the Contract Items for the Project.

1.2 CONTRACT ITEM 1 – WATER TREATMENT PLANT, COMPLETE

A. Description: The Work under this Contract Item includes providing all labor, materials, equipment, supplies and services, and performing all Work for installation, maintenance, testing, and placing into the trouble-free operation the designed water treatment plant along with all the associated equipment including but not limited to the rapid-mix chemical feed tank with vertical paddle system, sedimentation basin, relocation and replacement of media for existing filters, transfer pit, backwash/sludge pit, transfer pumps, high-service pumps, treatment building, all general, architectural, structural, mechanical, plumbing, electrical and instrumentation and control work in place, together with all appurtenant Work as shown and specified.

- B. Payment: Payment under Item 1 will be made at a Lump Sum Price.

1.3 CONTRACT ITEM 2 – ROCK EXCAVATION

A. Description: The Work under this Contract Item includes providing all labor, materials, equipment, supplies and services, and performing all Work for the excavation of rock as indicated on the plans and specified herein.

- B. Payment: Payment under Item 2 will be made at Lump Sum Price.

END OF SECTION 01 20 00

(NO TEXT FOR THIS PAGE)

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values (contract items) with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer in accordance with the General Conditions.
 - 3. Identify site mobilization, bonds and insurance.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of EJCDC Document C-620.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.

- b. Description of the Work.
- c. Name of subcontractor.
- d. Name of manufacturer or fabricator.
- e. Name of supplier.
- f. Change Orders (numbers) that affect value.
- g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Submittals.
 - 2) Labor.
 - 3) Materials.
 - 4) Equipment.
 - 5) Start-up/Testing.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.
- 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
- 6. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
- 7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
- B. Payment Application Times: Submit draft Application for Payment to Engineer by the second Tuesday of the month, or date otherwise discussed with owner. The period covered by each Application for Payment is one month, ending on the Friday prior to the second Tuesday of each month, or other date as discussed with owner.
- C. Application for Payment Forms: Use EJCDC Document C-620 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Do not include an Application for Payment for materials or equipment purchased or fabricated and stored, but not yet installed. Pay will be based on installed units.
- F. Transmittal: Submit four signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt. Include waivers of lien and similar attachments with each copy.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Lien: With each Application for Payment, except for the first, submit waivers of lien from entities lawfully entitled to a lien.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Submittal schedule (preliminary if not final).
 6. Copies of building permits.
 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Initial progress report.

9. Report of preconstruction conference.
- I. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 1. Evidence of completion of Project closeout requirements
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. Indiana State Form 34951
 5. Evidence that claims have been settled.
 6. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 7. Final liquidated damages settlement statement.
- K. Record Drawings: Keep all record drawings current. Recommendation for payment of pay application is subject to Engineer's review and confirmation that all record drawings are up to date.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION CONFERENCE

- A. The Engineer will schedule meeting after Notice of Award.
- B. Attendance Required: Owner, Engineer, Contractor, and Subcontractors.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreements.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of schedule of values and progress schedule.
 - 5. Designation of personnel representing Owner, Engineer, and Contractor.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Use of premises by Owner and Contractor.
 - 8. Owner's requirements.
 - 9. Construction facilities and controls.
 - 10. Temporary utilities.
 - 11. Survey.
 - 12. Security and housekeeping procedures.
 - 13. Procedures for testing.
 - 14. Procedures for maintaining record documents.
 - 15. Requirements for bringing new pipelines into service.
 - 16. Inspection and acceptance of equipment put into service during construction period.
- D. The Engineer will record minutes and distribute copies to participants and those affected by decisions made.

1.2 PROGRESS MEETINGS

- A. The Contractor will schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. The Contractor will arrange and preside at meetings. For these meetings, the contractor will create an agenda and provide participants with a copy.

- C. Attendance Required: Job superintendents, major subcontractors and suppliers, Owner, and Engineer, as appropriate to agenda topics for each meeting.
- D. Example Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Progress to date.
 - 3. Anticipated progress until next progress meeting.
 - 4. Identification of problems impeding planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Maintenance of progress schedule.
 - 7. Corrective measures to regain projected schedules.
 - 8. Review of Requests for Information (RFI's).
 - 9. Review of Requests for Proposal (RFP's).
 - 10. Review of Change Orders (CO's).
 - 11. Review of Pay Applications.
 - 12. Owner discussions, concerns, and comments.
 - 13. Engineer discussions, concerns, and comments.
 - 14. Other business relating to Work.
- E. The Contractor will record minutes and distribute copies to participants and those affected by decisions made.
 - 1. Distribute meeting notes to attendees within seven calendar days after each meeting and allow three days for review of meeting notes by all parties. After the three-day review period, re-distribute notes as required and prior to the next progress meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 19

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 3. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 4. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 5. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule within 5 calendar days from Notice to Proceed. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Engineer.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.

8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Engineer.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
 3. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using facsimile of sample form included in Project Manual transmittal form.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. ShareFile/FTP Website: Prepare submittals in PDF form, and upload to a ShareFile or FTP website. Enter required data in web-based software site to fully identify submittal.
 - a. Engineer will review and upload an annotated file to the web-based system.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as indicated in the General and Supplementary Conditions. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. Mark each copy of each submittal to show which products and options are specific to the project.
 2. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.

- d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 3. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 24 by 36 inches.
 - 3. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 4. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 5. Paper Transmittal: Include paper transmittal including complete submittal information indicated. Upload a copy of the transmittal to the ShareFile or FTP website for record keeping purposes.

6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit three full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned with Engineer comments.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- C. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.

4. Location within room or space.
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, reference contact information, and other information specified.
- E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- F. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- G. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ENGINEER'S REVIEW

- A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required and return it.

1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action as follows:
 - a. No Exceptions Taken:
 - 1) Where submittals are stamped "No Exceptions Taken". Work covered by submittal may proceed PROVIDED THE WORK COMPLIES WITH THE CONTRACT DOCUMENTS. Acceptance of Work will depend upon that compliance.
 - b. Make Corrections Noted:
 - 1) When submittals are stamped "Make Corrections Noted". Work covered by submittal may proceed PROVIDED IT COMPLIES WITH ENGINEER'S NOTATIONS AND CORRECTIONS ON SUBMITTAL AND WITH THE CONTRACT DOCUMENTS. Acceptance of Work will depend on that compliance.
 - c. Submit Specified Item:
 - 1) When submittals are stamped "Submit Specified Item" Contractor may proceed with Work covered by the submittal, except for the requested item, PROVIDED THE WORK COMPLIES WITH THE CONTRACT DOCUMENTS. Acceptance of Work will depend upon that compliance.
 - 2) Submit the requested item in accordance with Paragraph 1.7 of this Section.
 - d. Revise and Resubmit:
 - 1) When submittals are stamped "Revise and Resubmit" do not proceed with Work covered by submittal. Do not permit Work covered by submittal to use at Project site or elsewhere where Work is in progress.
 - 2) Revise submittal in accordance with Engineer's notations.

e. Rejected:

- 1) When submittals are stamped "Rejected" do not proceed with Work covered by submittal. Do not permit Work covered by submittal to be used at Project site or elsewhere where Work is in progress.
- 2) Provide a new submittal that meets the intent of the Specifications and in accordance with Engineer's notations.

B. Informational Submittals

1. When Informational Submittals conform to the format requirements in the Contract Documents, Engineer will acknowledge such submittals via a response transmittal.
2. If an Information Submittal does not conform to the format requirements of the Contract Documents, Engineer will return the submittal with comments or questions. Do not proceed with Work covered by the submittal and do not permit Work covered by the submittal to be used at Project site or elsewhere where Work is in progress. Resubmit the Information Submittal until the Engineer acknowledges that the submittal conforms to the format required.

- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval in writing from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Engineer will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Engineer without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUBMITTAL NUMBERING

- A. Number all submittals as follows:

(A) - (B)

Where:

(A) = Specification Section Number

(B) = Consecutive submittal number for the Specification Section Number listed in (A),

with an alphabetic suffix indicating the sequential version of the submittal.

Examples:

01 33 00-001A indicates the initial version of submittal number 001 for Specification Section 01 33 00.

01 33 00-001B indicates the second version of submittal number 001 for Specification Section 01 33 00.

01 33 00-002A indicates the initial version of submittal number 002 for Specification Section 01 33 00.

3.2 REPETITIVE REVIEWS

- A. Repetitive Reviews: Submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at times convenient to the Engineer based on the Engineer's then prevailing rates including all direct and indirect costs and fees. Contractor is not entitled to an increase in the Guaranteed Maximum Price for reimbursing Owner for all such costs and fees invoiced for third and subsequent submittals.

3.3 EXAMPLE FORMAT FOR CONTRACTOR'S APPROVAL AND CERTIFICATION STAMP

- A. An example format for the Contractor's approval and certification stamp is as follows:

| |
|---|
| CONTRACTOR'S NAME |
| ____ Approved and Certified to comply with the Contract Documents |
| ____ Approved and Certified to comply with Contract Documents, except for variations specifically noted on the Submittal Transmittal Form and the associated documents. |
| PRINTED NAME: _____ |
| TITLE: _____ |
| SIGNATURE: _____ |
| DATE: _____ |

3.4 CONTRACTOR'S SUBMITTAL TRANSMITTAL FORM

- A. The format for the Contractor's Submittal Transmittal form is as follows:

CONTRACTOR'S NAME
SUBMITTAL TRANSMITTAL FORM
SALT CREEK ESTATES WATER TREATMENT PLANT IMPROVEMENTS

TO: _____ DATE: _____
 SITE: _____
 ATTN: _____ SPEC. REF. NO.: _____
 DWG REF. NO.: _____
 FROM: _____ SUBMITTAL NO.: _____

1. The following documents are forwarded for your review:

| No. of Copies | Document Originator | Description | Document No. | Date |
|------------------|------------------------|-------------|-----------------|------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

2. Will item submitted for review fit in space provided in the Contract Document? _____ Yes _____ No _____ Not Applicable
3. Has work indicated in this submittal been coordinated with all trades? _____ Yes _____ No _____ Not Applicable
4. Has the Contractor approved submittal and affixed completed approval and certification stamp? _____ Yes _____ No
5. Contractor's description and justification for variations from the Contract Documents. (Use additional pages, if necessary)

6. Remarks: _____
-
-
-

Printed Name: _____

Signature: _____

3.5 SUBMITTAL REQUIREMENTS

- A. The schedule of submittals below is to be used only as a guide and is not guaranteed as a complete listing. Furnish submittals for any items of material or equipment required by the Technical Specifications.

| SECTION | ITEM DESCRIPTION | INFORMATIONAL SUBMITTAL | SHOP DRAWING PRODUCT DATA / LAYOUT DRAWINGS | INSTALLATION INSTRUCTIONS | DESIGN CALCULATIONS AND / OR PE APPROVALS | O&M MANUAL | START-UP REPORT | MANUFACTURERS WARRANTY / CERTIFICATION OF INSTALLATION | SAMPLES AND/OR CERTIFIED TEST REPORTS | DAYS DUE AFTER NOTICE TO PROCEED |
|----------|---|----------------------------|---|------------------------------|--|------------|-----------------|---|--|-------------------------------------|
| 01 33 00 | Submittal Procedures – Submittal Schedule | X | | | | | | | | 5 |
| 01 40 00 | Quality Requirements | X | | | | | | | | |
| 01 50 00 | Temporary Facilities and Controls | X | | | | | | | | |
| 01 60 00 | Product Requirements | X | | | | | | | | |
| 01 77 00 | Closeout Procedures | X | X | | | | | | | |
| 01 78 23 | Operation and Maintenance Data | X | | | | | | | | |
| 01 78 39 | Project Record Documents | X | | | | | | | | |
| | ALL Equipment | X | X | | | X | X | X | X | |

END OF SECTION 01 33 00

(NO TEXT FOR THIS PAGE)

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

- D. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.5 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for direction before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. **Testing Agency Qualifications:** For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. **Schedule of Tests and Inspections:** Prepare in tabular form and include the following:
 - 1. Specification section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. **Reports:** Prepare and submit certified written reports and documents as specified.
- D. **Permits, Licenses, and Certificates:** For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. **Test and Inspection Reports:** Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1.9 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections are contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the work complies with requirements.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of contractor by authorities having jurisdiction, whether specified or not.
 - 2. Engage a qualified testing agency to perform quality-control services.
 - 3. Notify testing agencies at least 48 hours in advance of time when work that requires testing or inspection will be performed.
 - 4. Where quality-control services are indicated as contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Field and Laboratory Tests: Provide personnel to perform the following periodic observation and associated services:
 - 1. Soils: Observe and test excavations, placement, and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.
 - 2. Concrete: Observe forms and reinforcement; observe concrete placement; perform and facilitate air entrainment and slump tests, and concrete cylinder preparation.
 - 3. Asphalt: Observe and test placement and compaction of asphalt. Observe subgrade soils to determine suitability for placement.
 - 4. Provide at least a 24-hour notice prior to when specified testing is required. Provide labor and materials, and necessary facilities at the site as required by the Engineer and the testing laboratory.
- C. Retesting/Reinspecting: Retest and reinspect construction that replaced work that failed to comply with the Contract Documents. Costs for retesting or reinspecting the work shall be incurred by the Contractor at no expense to the Owner.

- D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Security and protection for samples and for testing and inspection equipment at Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 COSTS OF INSPECTION

- A. Contractor's Obligation: Include in the Contract Price, the cost of all shop and field tests of materials and equipment specifically called for in the Contract Documents. The Owner may perform tests on any material furnished under this Contract at any time during the Contract. If tests performed by the Owner result in failure or rejection for noncompliance, reimburse the Owner for expenditures incurred in making such tests. Tests performed by the Owner shall prevail in determining compliance with Contract requirements.
- B. Reimbursements to Owner:

1. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Owner for compliance. Reimburse the Owner for expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.

1.11 ACCEPTANCE TESTS

- A. Preliminary Field Tests: As soon as conditions permit, furnish all labor and materials and services to perform preliminary field tests of all equipment provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.
- B. Final Field Tests: Upon completion of the Work and prior to final payment, subject all equipment, piping and appliances installed under this Contract to specified acceptance tests to demonstrate compliance with the Contract Documents.
 1. Furnish all labor, fuel, energy, water and other materials, equipment, instruments, and services necessary for all acceptance tests.
 2. Conduct field tests in the presence of the Engineer. Perform the field tests to demonstrate that under all conditions of operation each equipment item:
 - a. Has not been damaged by transportation or installation.
 - b. Has been properly installed.
 - c. Has been properly lubricated.
 - d. Has no electrical or mechanical defects.
 - e. Is in proper alignment.
 - f. Has been properly connected.
 - g. Is free of overheating of any parts.
 - h. Is free of all objectionable vibration.
 - i. Is free of overloading of any parts.
 - j. Operates as intended.
- C. Certificate of Compliance: Submit a notarized Certificate of Compliance for each equipment item. Provide Certificates in the form of a letter stating the following:
 1. Manufacturer has performed all required tests.
 2. Materials to be supplied meet all test requirements.
 3. Tests were performed not more than one year prior to submittal of the certificate.
 4. Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified.
 5. Identification of the materials.

- D. Failure of Tests: If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the Owner, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the Contractor to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

1.12 FAILURE TO COMPLY WITH CONTRACT

- A. Unacceptable materials: If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, do not deliver said material or equipment, or if delivered remove it promptly from the site or from the Work and replace it with acceptable material without additional cost to the Owner. Fulfill all obligations under the terms and conditions of the Contract even if the Owner or the Resident Project Representative fail to ascertain noncompliance or notify the Contractor of noncompliance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

- A. The following list of Testing Agencies are considered to be pre-approved and acceptable to perform the designated tests and inspections:
1. Earth Exploration
 2. Alt & Witzig
 3. ATC Group Services
 4. CTL Engineering
- B. Contractor may submit the qualifications of an alternate agency for approval by the Engineer.

3.2 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.

3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.3 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

(NO TEXT FOR THIS PAGE)

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 12. AGA - American Gas Association; www.aga.org.
 - 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 16. AIA - American Institute of Architects (The); www.aia.org.
 - 17. AISC - American Institute of Steel Construction; www.aisc.org.
 - 18. AISI - American Iron and Steel Institute; www.steel.org.
 - 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.

20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.

58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.

98. IAPSC - International Association of Professional Security Consultants;
www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IDEM - Indiana Department of Environmental Management; www.in.gov/idem/.
107. IEC - International Electrotechnical Commission; www.iec.ch.
108. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
109. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
110. IESNA - Illuminating Engineering Society of North America; (See IES).
111. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
112. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
113. IGSHPA - International Ground Source Heat Pump Association;
www.igshpa.okstate.edu.
114. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
115. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA);
www.intertek.com.
116. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
117. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
118. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
119. ISO - International Organization for Standardization; www.iso.org.
120. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
121. ITU - International Telecommunication Union; www.itu.int/home.
122. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
123. LMA - Laminating Materials Association; (See CPA).
124. LPI - Lightning Protection Institute; www.lightning.org.
125. MBMA - Metal Building Manufacturers Association; www.mbma.com.
126. MCA - Metal Construction Association; www.metalconstruction.org.
127. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
128. MFMA - Metal Framing Manufacturers Association, Inc.;
www.metalframingmfg.org.
129. MHIA - Material Handling Industry of America; www.mhia.org.
130. MIA - Marble Institute of America; www.marble-institute.com.
131. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
132. MPI - Master Painters Institute; www.paintinfo.com.
133. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
134. NAAMM - National Association of Architectural Metal Manufacturers;
www.naamm.org.
135. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.

136. NADCA - National Air Duct Cleaners Association; www.nadca.com.
137. NAIMA - North American Insulation Manufacturers Association;
www.naima.org.
138. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
139. NBI - New Buildings Institute; www.newbuildings.org.
140. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
141. NCMA - National Concrete Masonry Association; www.ncma.org.
142. NEBB - National Environmental Balancing Bureau; www.nebb.org.
143. NECA - National Electrical Contractors Association; www.necanet.org.
144. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
145. NEMA - National Electrical Manufacturers Association; www.nema.org.
146. NETA - InterNational Electrical Testing Association; www.netaworld.org.
147. NFHS - National Federation of State High School Associations; www.nfhs.org.
148. NFPA - National Fire Protection Association; www.nfpa.org.
149. NFPA - NFPA International; (See NFPA).
150. NFRC - National Fenestration Rating Council; www.nfrc.org.
151. NHLA - National Hardwood Lumber Association; www.nhla.com.
152. NLGA - National Lumber Grades Authority; www.nlga.org.
153. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
154. NOMMA - National Ornamental & Miscellaneous Metals Association;
www.nomma.org.
155. NRCA - National Roofing Contractors Association; www.nrca.net.
156. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
157. NSF - NSF International; www.nsf.org.
158. NSPE - National Society of Professional Engineers; www.nspe.org.
159. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
160. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
161. NWFA - National Wood Flooring Association; www.nwfa.org.
162. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
163. PDI - Plumbing & Drainage Institute; www.pdionline.org.
164. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); <http://www.plasa.org>.
165. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
166. RFCI - Resilient Floor Covering Institute; www.rfci.com.
167. RIS - Redwood Inspection Service; www.redwoodinspection.com.
168. SAE - SAE International; www.sae.org.
169. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
170. SDI - Steel Deck Institute; www.sdi.org.
171. SDI - Steel Door Institute; www.steeldoor.org.
172. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
173. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers;
(See ASCE).
174. SIA - Security Industry Association; www.siaonline.org.
175. SJI - Steel Joist Institute; www.steeljoist.org.
176. SMA - Screen Manufacturers Association; www.smainfo.org.
177. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association;
www.smacna.org.
178. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.

179. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
180. SPIB - Southern Pine Inspection Bureau; www.spib.org.
181. SPRI - Single Ply Roofing Industry; www.spri.org.
182. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
183. SSINA - Specialty Steel Industry of North America; www.ssina.com.
184. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
185. STI - Steel Tank Institute; www.steeltank.com.
186. SWI - Steel Window Institute; www.steelwindows.com.
187. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
188. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
189. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
190. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
191. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
192. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
193. TMS - The Masonry Society; www.masonrysociety.org.
194. TPI - Truss Plate Institute; www.tpinst.org.
195. TPI - Turfgrass Producers International; www.turfgrasssod.org.
196. TRI - Tile Roofing Institute; www.tilerroofing.org.
197. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
198. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
199. USAV - USA Volleyball; www.usavolleyball.org.
200. USGBC - U.S. Green Building Council; www.usgbc.org.
201. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
202. WA - Wallcoverings Association; www.wallcoverings.org
203. WASTEC - Waste Equipment Technology Association; www.wastec.org.
204. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
205. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
206. WDMA - Window & Door Manufacturers Association; www.wdma.com.
207. WI - Woodwork Institute; www.wicnet.org.
208. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
209. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

(NO TEXT FOR THIS PAGE)

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary for Work" restrictions and limitations on utility interruptions.
 - 2.

1.3 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.4 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner and Owner's staff, Engineer, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

- E. Provide water and electric meters for water and electric power services connections. Coordinate with Owner on whether a specific meter type is required for monitoring service.

1.5 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

1.6 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
- B. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Contractor's Office: Erect, furnish, and maintain a field office. Have an authorized agent present at this office at all times while the Work is in progress. Keep readily accessible copies of the Contract Documents, required record documents, and the latest approved shop drawings at this field office.
- C. Coordinate location of field offices, material sheds and temporary structures with Engineer and Owner.
- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
- E. Store combustible materials apart from building.
- F. Utility Connections:
 - 1. Connect the water and sanitary sewer to existing lines. If there are no available sanitary sewers:
 - a. Provide and maintain, throughout the duration of the construction project, portable commodes next to the field office trailer.
 - b. Install Sanitary Holding Tank at project inception and connect the trailer sanitary sewer to the Holding Tank. Pump out tank on not less than a weekly basis.
 - c. Provide a suitable water meter installation in accordance with local ordinances. Pay each monthly water bill cost.
 - d. Arrange for the local power company to provide separate, complete and metered electrical service to the field office. Provide a suitable meter installation as approved. Connect the electrical service to the trailer to provide a complete operating installation.
 - e. Arrange with the local internet service Contractor to provide either DSL or cable modem service to the field office. Pay each monthly internet connection charge.
- G. Final Ownership: At the completion of construction, the printer equipment will become the property of the Owner. The trailer and all other furnishings shall remain the property of the Contractor.
- H. Trailer Removal: Subsequent to final completion, remove trailer from the project site and transport the trailer off-site. Remove all trailer foundations, anchors, supports, and utility connections. Restore site to its original condition or better.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
- C. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
- D. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- B. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- C. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.

- B. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 - C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
 - D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Prohibit and prevent nuisances on the site of the Work or on adjoining property. Discharge any employee who violates this rule. Abide by all environmental regulations or laws applicable to the Work.
 - E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - F. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
 - G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - H. Install electric power service as noted on the Drawings.
 - I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - J. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- 3.4 SUPPORT FACILITIES INSTALLATION
- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

2. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove after the Substantial Completion walkthrough has been performed. Maintain only the temporary facilities required to achieve Final Completion. Contractor's personnel are not permitted to use the permanent facilities.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 25 00 "Erosion and Sedimentation Controls."
 3. Recondition base after temporary use, including removing contaminated material, regrading, proof rolling, compacting, and testing.
 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 32 12 16 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 3. Provide temporary, directional signs for construction personnel and visitors.
 4. Maintain and touch up signs so they are legible at all times.
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- C. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- D. Comply with work restrictions specified in Section 01 10 00 "Summary."
- E. Temporary Erosion and Sedimentation Control: Comply with requirements of the IDEM Rule 5 Permit and requirements specified in Section 31 10 00 "Site Clearing" and the Drawings.
- F. Storm water Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.

- G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
- I. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- J. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- K. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- L. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- N. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
- C. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
- F. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 1. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Engineer through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. All product warranties shall commence at the date of Substantial Completion unless specified otherwise in the individual Specification Sections.
- D. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in the General Conditions to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2.2 "OR-EQUAL" PRODUCTS

- A. Conditions for Consideration of Or-Equal Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Contractor may return requests without action, except to record noncompliance with these requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses, and contact information for references, if requested.

- 4. Samples, if requested.
- B. Submittal Requirements: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 71 23 – LINES AND GRADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General
- B. Surveys
- C. Datum Plane
- D. Protection of Survey Data

1.2 GENERAL

- A. Construct all work in accordance with the lines and grades shown on the Drawings. Assume full responsibility for keeping all alignment and grade.

1.3 SURVEYS

- A. Control Points: Base horizontal and vertical control points will be established or designated by the ENGINEER and used as datum for the Work. Perform all additional survey, layout, and measurement work.

1. Keep ENGINEER informed, sufficiently in advance, of the times and places at which work is to be performed so that base horizontal and vertical control points may be established and any checking deemed necessary by ENGINEER may be done, with minimum inconvenience to the ENGINEER and at no delay to CONTRACTOR. It is the intention not to impede the Work for the establishment of control points and the checking of lines and grades set by the CONTRACTOR. However, when necessary, suspend working operations for such reasonable time as the ENGINEER may require for this purpose. Costs associated with such suspension are deemed to be included in the Contract Price, and no time extension or additional costs will be allowed.

2. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the CONTRACTOR.

1.4 DATUM PLANE

A. All elevations indicated or specified refer to the Mean Sea Level Datum Plane, 1929 General Adjustment, of the United States Coast and Geodetic Survey and are expressed in feet and decimal parts thereof, or in feet and inches.

1.5 PROTECTION OF SURVEY DATA

A. General: Safeguard all points, stakes, grade marks, known property corners, monuments, and bench marks made or established for the Work. Reestablish them if disturbed, and bear the entire expense of checking reestablished marks and rectifying work improperly installed.

B. Records: Keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Furnish copies of such data to the ENGINEER for use in checking the CONTRACTOR's layout. Data considered of value to the OWNER will be transmitted to the OWNER by the ENGINEER with other records on completion of the Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.4 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - 1. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Certified Surveys: Submit two copies signed by land surveyor.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
 - 1. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the Contractor.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.7 DATUM PLANE

- A. All elevations indicated or specified refer to the NAD83, UTM Zone 16, US Foot and are expressed in feet and decimal parts thereof, or in feet and inches.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer in accordance with the General Conditions.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish limits on use of Project site.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Control Points: Base horizontal and vertical control points are established in the Drawings and are to be used as the datum for the Work.
- D. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- E. Protection: Safeguard all points, stakes, grade marks, known property corners, monuments, and benchmarks made or established for the Work. Re-establish them if disturbed, and bear the entire expense of checking re-established marks and rectifying work improperly installed.
- F. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

- A. Identification: Existing benchmarks, control points, and property corners are shown on the Drawings.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points. Report lost or destroyed permanent benchmarks or control points promptly.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.

- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- F. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- G. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- H. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

3.9 Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 79 00 "Demonstration and Training."

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General Requirements
- B. Scheduling of Shutdown

1.2 RELATED SECTIONS

Related Work Specified in Other Sections Includes, But is Not Limited to, the Following

- A. Section 01 11 00 - Summary of Work

1.3 GENERAL REQUIREMENTS

- A. Coordination: Perform all cutting, fitting or patching of the Work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.
- B. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new Work in the existing construction.
- C. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without the ENGINEER's concurrence.

1.4 SCHEDULING OF SHUTDOWN

- A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the OWNER's normal operation is minimal. Overtime, night and weekend work without additional compensation from the OWNER, may be required to make these connections, especially if the connections are made at times other than those specified.

- B. Request for Shutdowns: Submit a written request for each shutdown to the OWNER and the ENGINEER sufficiently in advance of any required shutdown.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Safeguards: Provide all shoring, bracing, supports, and protective devices necessary to safeguard all work and existing facilities during cutting and patching operations.
- B. Location of Embedments: Employ impulse radar (non x-ray type) nondestructive testing prior to core drilling or cutting of existing walls, floors and ceilings to identify location of embedded pipes or conduits.
- C. Material Removal: Cut and remove all materials to the extent shown or as required to complete the Work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials which are not salvageable from the site.

3.2 RESTORATION

- A. Final Appearance and Finish: Restore all work and existing facilities affected by cutting operations, with new materials, or with salvaged materials acceptable to the ENGINEER, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, patch and refinish entire surfaces.

END OF SECTION 01 73 29

SECTION 01 74 00 – CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Final Cleaning
- B. Final Inspection

1.2 FINAL CLEANING

A. Requirements: At the completion of work and immediately prior to final inspection, clean the entire project as follows:

1. Thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.
2. Direct all subcontractors to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.
3. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.
4. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.

B. Employ experienced workers, or professional cleaners, for final cleaning.

C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

- F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.
- G. Remove snow and ice from access to buildings.
- H. Replace air-handling filters if units were operated during construction.
- I. Clean ducts, blowers, and coils, if air-handling units were operated without filters during construction.
- J. Vacuum clean all interior spaces, including inside cabinets.
- K. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- L. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.
- M. Clean interior of all panel cabinets, pull boxes, and other equipment enclosures.
- N. Wash and wipe clean all lighting fixtures, lamps, and other electrical equipment which may have become soiled during installation.
- O. Perform touch-up painting.
- P. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- Q. Remove erection plant, tools, temporary structures and other materials.
- R. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

1.3 FINAL INSPECTION

- A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the OWNER and ENGINEER.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION 01 74 00

(NO TEXT FOR THIS PAGE)

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of one week prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance and material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.
 - 5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures prior to Substantial Completion: Complete the following a minimum of one week prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 8. Complete final cleaning requirements.
 9. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of seven days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.
- 1.7 FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 01 29 00 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of one week prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order.
 - 2. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Page number.
 - 3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file or PDF electronic file. Engineer will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1.10 COMMISSIONING BINDER

- A. Upon completion of training for each equipment item, and prior to Final Completion, provide one (1) commissioning binder. Identify each section based on the equipment using heavy sections dividers with reinforced holes and numbered plastic index tabs. Use 3-ring, slant ring, hard-back binders, Type No. AVE-VS11 as manufactured by Avery Company, or equal. Binder size shall be 3-inch maximum. Punch all loose data for binding. Arrange composition and printing so that punching does not obliterate any data.
- B. At a minimum for each section, i.e. equipment item, provide the following:

1. Certificate of Installation, Inspection and Start-up Services
2. Equipment Data Summary
3. Equipment Preventative Maintenance Summary
4. Manufacturer's Operating and Maintenance Instructions
5. Certificate of Instructional Services
6. Manufacturer's Start-up and Installation Checklists
7. Warranty

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected of a typical municipal water treatment building. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.

- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters to comply with requirements for new fixtures.

END OF SECTION 01 77 00

(NO TEXT FOR THIS PAGE)

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 01 79 00 "Demonstration and Training" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Owner will comment on whether content of operation and maintenance submittals is acceptable.
 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
- C. Initial Manual Submittal: Submit draft copy of each manual at 50% project completion in electronic PDF format. Do not submit O&M Manuals prior to shop drawing approval. Engineer will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training in electronic PDF format. Engineer will return copy with comments.
1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 10 days prior to commencing demonstration and training. Provide one digital copy, in PDF Format, and three hard copies of each manual.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title, Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
3. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold, and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.

4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Engineer.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents.
- 1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL
- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- 1.8 EMERGENCY MANUALS
- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION AND MAINTENANCE MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, routine and special operating procedures, manufacturers' maintenance documentation, preventative maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Content: In addition to requirements in this Section, include operation and maintenance data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
 11. Manufacturers' Maintenance Documentation
- D. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- E. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- F. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- G. Piped Systems: Diagram piping as installed and identify color coding where required for identification.
- H. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions, bulletins, and procedures; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Maintenance and service schedules.
 3. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 4. Identification and nomenclature of parts and components.
 5. List of items recommended to be stocked as spare parts.
 6. Warranties and Bonds
- I. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- J. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
 - K. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 - L. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.
 - M. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of maintenance manuals.
- 1.10 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
 - B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 - C. Source Information: List each product included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
 - D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
 - E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SALT CREEK ESTATES INC. NASHVILLE, INDIANA

SALT CREEK ESTATES WATER TREATMENT PLANT IMPROVEMENTS

Equipment Data Summary

Equipment Tag:

Specification Reference:

Manufacturer:

Name:

Address:

Telephone:

Number Supplied:

Location/Service:

Model No:

Serial No:

Type:

Size/Speed/Capacity/Range (as applicable):

Power Requirement (Phase/Volts/Hertz):

Local Representative:

Name:

Address:

Telephone:

NOTES:

SALT CREEK ESTATES INC. NASHVILLE, INDIANA

SALT CREEK ESTATES WATER TREATMENT PLANT IMPROVEMENTS

Preventive Maintenance Summary

Equipment Tag:

Location:

Model No:

Serial No:

| Maintenance Task | Lubricant/Part | D W M Q SA A | O&M Manual Reference |
|------------------|----------------|--------------|-------------------------|
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NOTES:

*D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

(NO TEXT ON THIS PAGE)

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for final property survey
 - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints.
 - 2) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one paper-copy set of marked-up record prints
 - 2) Submit PDF electronic files of scanned record prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.

- B. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit number of copies of each submittal as defined in the various Specification Sections.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Locations and depths of underground utilities.
 - d. Revisions to routing of piping and conduits.
 - e. Revisions to electrical circuitry.
 - f. Changes made by Change Order or Work Change Directive.
 - g. Changes made following Engineer's written orders.
 - h. Details not on the original Contract Drawings.
 - i. Field records for variable and concealed conditions.
 - j. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
- 1.5 RECORD PRODUCT DATA
- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders and record Drawings where applicable.
- 1.6 MISCELLANEOUS RECORD SUBMITTALS
- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: Submit for approval, credentials of equipment manufacturer representatives who are to be course instructors at least 15 days prior to the training sessions.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit one copy within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Date of video recording.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 3. At completion of training, compile transcripts and submit complete training manual(s) for Owner's use prepared in both hard copy and electronic format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.

- b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:

- a. Diagnosis instructions.
- b. Repair instructions.
- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Owner's operations staff with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner unless instructed otherwise. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

3.1 TRAINING SESSIONS

- A. Conduct all training during regular hours on weekdays and coordinate the scheduling of all training with the Owner and Operators.
- B. Perform training utilizing actual equipment in service. Use of equipment for training will not void manufacturers' or contract warranties.
- C. Provide training for the following:

| <u>Specification Section</u> | <u>Equipment Name</u> | <u>Minimum Training Hours</u> |
|------------------------------|---------------------------------------|-------------------------------|
| See Plans | SCADA System | 40 |
| See Plans | Sedimentation Tank | 4 |
| See Plans | Filters | 4 |
| 46 23 31.23 | Pumps (High-Service & Transfer Pumps) | 8 |
| See Plans | Rapid Mix Chemical Tank | 4 |

END OF SECTION 01 79 00

CERTIFICATE OF INSTRUCTIONAL SERVICES

Project: _____

Equipment: _____

Specification Section: _____

I hereby certify the equipment Manufacturers' Representative has instructed Owner's personnel in startup operation and maintenance of this equipment as required in the Contract Documents.

Manufacturer's Representative

Signature _____

Name: (print) _____

Title: _____

Representing _____

Contractor

Signature _____ Date _____

Name (print) _____

Title _____

Owner

Signature _____ Date _____

Name (print) _____

Title _____

Comments:

Complete and submit this form to Engineer upon completion of training as required by Specification Section 01 79 00.

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Demolition and removal of selected site elements.
- 2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

- 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 01 50 00 "Temporary Facilities and Controls" for the preconstruction video.
- 3. Section 01 73 00 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 REFERENCES

- A. Codes and standards referred to in this Section are:

1. ANSI/ASSE A10.6 - Safety & Health Program Requirements for Demolition Operations
2. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.5 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 INFORMATIONAL SUBMITTALS

- A. Demolition Plan
 1. Include Proposed Protection Measures: Submit plan that indicates the measures proposed for protecting individuals, property, and adjacent buildings, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
 2. Plan should provide the most expeditious dismantling of the structure safely feasible to minimize the duration of time partially standing structures remain.
- B. Preconstruction/Predemolition Photographs or Video: Submit before Work begins.
- C. Contractor shall provide thorough and complete written documentation of the demolition of the elevated tank. The documentation shall include a description of the material, date of removal, and date of delivery to the receiving facility if requested. The documentation shall include the written verification of the receiving facility.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes if required.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is expected that lead paint will be encountered in the Work. specifically in the existing elevated storage tank. Follow 29 CFR 1910.1025(a)(2) for protection during demolition.
 - 1. If other suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. They will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

3.2 DAMAGE SURVEY.

- A. Requirements: Conduct a damage survey of the Work site and adjacent properties prior to commencing the Work and before making application for final payment for the Work. Owner shall be present during the videotaping. Provide Owner with two copies of the videotaping on USB drives. Record all planned construction areas, material storage areas, areas adjacent to these areas, including but not limited to, farmland, streets, driveways, sidewalks, curbs, ditches, fencing, railing, visible utilities, retaining structures, landscaping and trees, and adjacent building structures. The purpose of the video is to document existing site conditions and to provide a fair measure of required restoration. Care should be taken to record all existing conditions which exhibit deterioration, imperfections, structural failures, or situations that would be considered substandard. The video image shall be of sufficient detail to delineate important features and conditions of the project area including public right-of-way and adjacent private property.
- B. No recording shall be performed during periods of precipitation, mist, fog or when the ground is covered in snow. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recording. The audio portion of the recording shall reproduce precise and concise explanatory notes by the camera operator with proper volume, clarity and freedom from distortion.
- C. At the start of production and at the beginning of a new street, building or basement, an identification summary shall be read into the recording while using a wide-angle view of the video to display numeric displays for visual record. This summary shall include: 1) tape number; 2) project name; 3) job location; 4) positional location at start of job; 5) date and time; 6) weather; 7) direction of camera; 8) any other notable conditions.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 01 10 00 "Summary."

- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.4 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches.
 - 4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 6. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area as designated by Owner.
 - 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them at the expense of the Contractor. The Contractor shall bear full responsibility for any and all fines against the project resulting from improper handling and disposal of the waste materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

(NO TEXT FOR THIS PAGE)

SECTION 03 10 00 – CONCRETE FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish, install, and remove all formwork for all cast-in-place concrete as shown or implied on the Contract Documents.
2. Design of formwork, shoring and reshoring.

B. Related Sections:

1. Division 03 Section: Concrete Reinforcement
2. Division 03 Section: Cast-in-Place Concrete

1.2 QUALITY ASSURANCE

A. Qualifications of Workmen:

1. Provide at least one person who shall be present at all times during execution of this portion of the Work.
2. This workman shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this work.
3. This workman shall direct all work performed under this Section.

B. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations and maintain tolerances contained in "Recommended Practice for Concrete Formwork," publication ACI 347-Latest Edition of the American Concrete Institute.
2. Where provisions of pertinent codes and standards conflict with the requirements of this Section of the Project Manual, the more stringent provisions shall govern.
3. Tolerance limits per ACI 117-Latest Edition.
 - a. Form concrete and set screeds or bulkheads so maximum variation in slab elevation in any bay does not exceed 1/2 inch.

C. Design:

1. Design of formwork, shoring and reshoring by a Professional Engineer of the State where the project is located.

1.3 PRODUCT HANDLING

A. Protection:

1. Use all means necessary to protect formwork materials before, during, and after installation and to protect the installed work and materials of all other trades.
2. Special precautions, as required to protect permanent steel forms and formwork for exposed concrete, shall be utilized after erection.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Form Lumber:

1. All form lumber in contact with exposed concrete shall be new or of sufficient quality to insure an unblemished texture.
2. All form lumber shall be one of the following or a combination thereof.
 - a. Plywood, board lumber, hardwood, or other material of grade or quality to best suit each particular usage.

B. Steel Forms:

1. Steel is an acceptable material for formwork.
2. Steel forms shall be "like new" producing a clean, smooth, unblemished texture for concrete exposed in the finished structure. Do not use damaged forms.

C. Corrugated Steel Permanent Form:

1. Where shown on the Contract Drawings, provide and install galvanized 26 gauge corrugated steel forms.
 - a. Nominal depth: 1"
 - b. Minimum section modulus: 0.075 inch-cubed per 1 foot width
 - c. Minimum tensile strength: 80,000 psi
2. This permanent steel form acts only as form, unlike the products defined in Division 05 Section: Composite Metal Decking, which also provide positive moment reinforcement.

D. Fiber Forms:

1. Fiber forms may be utilized to construct round columns/piers.
2. Seamless forms shall be used for concrete exposed in the finished structure.

3. Standard seamed tubes are permissible for non-exposed concrete.
- E. Form Release Agent: Provide non-staining and non-emulsifiable form release agent.
 1. Standards:
 - a. Release agent shall be similar to Magic Kote by Dayton Superior.
 - b. Acceptable manufacturer: BASF Construction Chemicals, W.R. Meadows
- F. Bracing/Shoring/Studs:
 1. Such supports shall be selected for economy consistent with safety requirements and the quality required in the finished work. The Contractor is responsible for the design, illustration, safety, and serviceability of all formwork.

2.2 TIES/SPREADERS/ACCESSORIES

- A. Type:
 1. All form ties shall be a type which does not leave an open hole through the concrete and which permits neat and solid patching at every hole.
 2. Spreaders shall be commercially manufactured devices compatible with the system.
- B. Design:
 1. When forms are removed, ties remaining within the concrete shall be not less than 1" from the surface.
 2. Utilize ties with removable plastic cones where concrete will be exposed in the finished structure.
- C. Wire Ties and Wood Spreaders:
 1. Do not use wire ties and wood spreaders.
- D. Other Materials:
 1. All other materials not specifically described but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to advance acceptance by the Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all trades and verify that all such work is complete to the point where form installation may properly commence.
2. Review the Contract Documents, including Addenda and Post Bid Revisions, as applicable, to determine all Contract requirements/details.
3. Verify that forms may be constructed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect/Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 CONSTRUCTION OF FORMS

A. General:

1. Construct all required forms to be substantial, sufficiently tight to prevent leakage of mortar.
2. The design and engineering of the formwork shall be the responsibility of the Contractor.
3. Formwork shall be designed for wet concrete and construction loads, lateral pressures, wind loads, and all other loads anticipated during construction.
4. Provide shoring and bracing as required to prevent undue deflection or bulging of concrete.
5. Provide removable sections at the base of forms, where required, to permit removal of debris, water, etc., from the formwork for walls and deep beams.

B. Layout:

1. Form for all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the drawings.
2. Exercise particular care in the layout of forms to ensure the proper finish structure size and shape.
3. Make proper provision for all openings, offsets, recesses, anchorage, blocking, and other features of the Work as shown or required.
4. Carefully examine the Contract Documents and consult with other trades as required to insure proper provisions for openings, reglets, chases, and other items in the forms.
5. Camber forms as required to allow for form deflections, slippage, and settlement of shores during concrete placement.

C. Embedded Items:

1. Set all required steel frames, angles, grilles, bolts, reglets, inserts, pipe, conduit, and other such items required to be anchored in the concrete before the concrete is placed.

D. Bracing and Shoring:

1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel.
2. Construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
3. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
4. All shoring shall extend to adequate foundations.
5. Shores supporting successive stories shall be placed directly over those below or be so designed and placed to prevent overload on the structure below.
6. The Contractor is responsible for both the proper design and installation of all bracing and shoring, to properly ensure the safety and serviceability of the structure.

E. Tolerances:

1. Construct all forms straight, true, plumb, and square within the tolerances recommended by ACI 347.
2. Formed surfaces shall be Class A.
 - a. Abrupt irregularities in formed surfaces exposed to view in final construction shall not exceed 1/8 inch.
3. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 - a. Level Alignment: Variance in elevation of top of slab in any structural bay shall not exceed 1/2 inch.

F. Wetting:

1. Keep forms sufficiently wetted to prevent joints opening up before concrete is placed, except as recommended in ACI 306 R-78, "Recommended Practice for Cold Weather Concreting."

G. Construction Joints:

1. Refer to Division 03 Section: Cast-In-Place-Concrete of this Project Manual.

3.3 PLYWOOD FORMS

A. Assembly:

1. Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.

B. Joints:

1. Make all panel joints tight butt joints with all edges true and square.

3.4 FOOTING FORMS

A. Side Forms:

1. All footing sides shall be formed unless otherwise specifically authorized by the Architect/Engineer.

3.5 REUSE OF FORMS

A. Requirements:

1. Reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
2. Reuse of forms shall in no way impart less structural stability to the forms, nor less acceptable appearance to finished concrete.

3.6 CLEAN-UP

A. General:

1. Before concrete is placed the forms shall be cleaned of all debris, ice, snow, frost, and standing water.
2. Remove all loose earth materials from the surfaces of earth forms.

3.7 REMOVAL OF FORMS

A. General:

1. Forms shall be removed in such manner to ensure complete safety of the structure.
2. Formwork for columns, walls, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations with the following minimums:
 - a. Formwork for walls and columns shall remain in place a minimum of two (2) days during which the temperature of the air surrounding the concrete must be above 50°F.
 - b. This minimum time period represents a cumulative number of days or fractions thereof.

- c. Such formwork for concrete placed during cold weather with surrounding air temperatures below 50°F shall remain in place one day after the artificial heating and/or freeze protection is discontinued/ removed.
3. Forms and falsework supporting any vertical loads shall remain in place until the members have acquired sufficient strength to safely support their weight and any superimposed loads. Such forming shall remain in place until the concrete has attained its specified 28 day strength as indicated by the test cylinders unless reshores are installed in sufficient quantities to transmit the loads to adequate foundations without over stressing the partially cured structure. The requirements of ACI 305 and 306 must also be met before forms may be removed.
4. Forms for load bearing superstructure concrete shall never be removed earlier than seven (7) days after the concrete is placed.
5. Removal of forms and falsework is the responsibility of the Contractor, and the Contractor shall bear the full responsibility for this operation.
6. Concrete damaged by too early removal of forms or falsework shall be repaired or replaced as directed by the Architect/Engineer.
7. Concrete exposed by form removal during the curing period shall be cured by one of the methods specified in Division 03 Section: Cast-In-Place-Concrete.
8. Note that curing compound is not permitted in certain locations. In these cases, curing is to be by an alternate method. See Cast-in-Place Concrete specification for alternate methods.
9. In no case shall the superimposed load on relatively new concrete exceed 50 pounds per square foot unless proper shoring to suitable foundations is installed as required by the Architect/Engineer.

B. Removal

1. Use all means necessary to protect workmen, passers-by, the installed work and materials of other trades, and the complete safety of the structure.
2. Cut nails and similar fasteners off flush and leave all surfaces smooth and clean.
3. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.

END OF SECTION 03 10 00

SECTION 03 20 00 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install all bar supports, inserts, anchor bolts, welded wire fabric, reinforcing bars and all other items to be embedded in the cast-in-place concrete, not specifically indicated to be by others, as shown or implied on the Contract Documents.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Cast-in-Place Concrete

1.2 QUALITY ASSURANCE

A. Qualifications of Workmen:

1. Provide at least one person who shall be present at all times during execution of this portion of the work.
2. This workman shall be thoroughly familiar with the type of materials being installed and the best methods for their installation.
3. This workman shall direct all work performed under this Section.

B. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures and ACI 318 - Building Code Requirements for Reinforced Concrete.
2. Where provisions of pertinent codes and standards conflict with this Section of the Project Manual, the more stringent provisions shall govern.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings to the Architect/Engineer defining details of concrete reinforcement in accordance with Division 01 Section: Submittals of this Project Manual.
2. Reinforcing for concrete walls shall be shown on scale elevations of the walls.

3. The Contractor may release shop drawings for fabrication at his discretion; however, the Contractor shall bear all financial responsibility for changes to the shop drawings up to the time they are marked "Furnish as Submitted." Actual field installation shall only be made with shop drawings marked "Furnish as Submitted."
4. Where hooks are indicated on the Contract Drawings, provide standard hooks unless otherwise noted.
5. All accessories necessary for support of reinforcing steel shall be shown in plan. Do not schedule accessories.

B. Certifications:

1. Submit a certification that all material used is in accordance with the requirements of this Section.

1.4 PRODUCT HANDLING

A. Protection:

1. Use all means necessary to protect concrete reinforcement before, during, and after installation and to protect the installed work and materials of all other trades.
2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.

B. Replacements:

1. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars and Dowels:

1. Conform to ASTM A615, Grade 60.
2. Reinforcing that is to be welded shall conform to ASTM A615, Grade 40.
3. Epoxy coated bars (required only where noted) shall meet the requirements of ASTM A884.

B. Welded Wire Fabric:

1. Conform to ASTM A1064, 6 x 6 x W 2.1x W 2.1, or as indicated on the drawings. Welded wire fabric shall be furnished in the flat sheet form in lieu of roll form.
2. Epoxy coated welded wire fabric (required only where noted) shall meet the requirements of ASTM A884.

C. Other Embedded Items:

1. Provide standard manufactured products as approved by the Architect/Engineer.

D. Bar Supports:

1. Conform to the requirements of the "Manual of Standard Practice," published by the Concrete Reinforcing Steel Institute.
2. Accessories shall be plastic protected Class "C" for all concrete exposed in the finished structure, except as specified below.
3. Accessories shall be Class "A," bright basic, for unexposed concrete.
4. Utilize Class "E," stainless steel bar supports, for exterior concrete to be finished by sand blasting.
5. Do not use continuous high chairs. Use individual high chairs laced with bottom cross bars plus #5 support bars. (Minimum of 2 rows of supports for all reinforcing.)
6. Supports must be capable of supporting construction loads without failing. Contractor to furnish additional supports at no cost to the Owner if in the Architect/Engineer's estimation the supports are not adequate.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that concrete reinforcement may be installed in strict accordance with all pertinent codes and regulations and original design.

B. Discrepancies:

1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. General:

1. Remove all dirt, oil, paint, loose rust, and other foreign materials from the concrete reinforcement prior to replacement.

3.3 PLACING

A. Reinforcing Bars:

1. Place reinforcing steel accurately in conformance with shop drawings stamped "Furnish as Submitted" by the Architect/Engineer.
2. Positively secure reinforcing to bar supports and tie or otherwise anchor bars to prevent displacement by construction loads or by the placing of concrete.
3. Splice bars with a minimum lap of 40 bar diameters, unless otherwise indicated. Use mechanical splicers/couplers where quantity of reinforcement restricts placement of concrete if lapped splices are utilized. Install mechanical splice as recommended by manufacturer.
4. Splice bars only at locations indicated on the Contract Documents and shop drawings.
5. Both shop and field bending shall be accomplished without heating the bars.
6. Minor placing adjustments can be made to avoid interference with other reinforcement and/or embedded devices. The final arrangement, however, is subject to review and acceptance of the Architect/Engineer.
7. Immediately notify the Architect/Engineer if reinforcing cannot be installed as detailed on the "Furnish as Submitted" shop drawings. No cutting of reinforcing should occur unless the Architect/Engineer has reviewed and allowed such cuts.

B. Embedded Devices:

1. Set hangers, anchor bolts, inserts, and other embedded devices accurately in place.
2. Make sure all such devices are installed so that work to be attached thereto will be properly received.
3. Keep devices straight and true-to-line.

C. Welded Wire Fabric:

1. Splice the welded wire fabric by lapping each section at least two meshes wide plus one wire with the adjacent section, but not less than 8".
2. Extend fabric into all openings, doorways, and the like, unless otherwise indicated.
3. Reinforce all equipment pads with 6x6-W2.1xW2.1 welded wire fabric unless otherwise indicated.
4. Support the welded wire fabric in slab-on-grade, with #4 continuous bars spaced at 2'-6" o.c. (maximum in one direction) and supported on concrete brick spaced at 2'-6" o.c.

3.4 CLEANING REINFORCING

A. Final Cleaning:

1. Prior to casting concrete, all loose mill and rust scale, oil, mud, ice, and other foreign coatings which destroy and/or reduce bond between the reinforcement and concrete shall be removed.
2. Wire brushing and/or other suitable methods shall be used to complete cleaning operations.

3.5 INSPECTION

A. Scheduling:

1. Notify the Architect/Engineer 24 hours in advance that forms and reinforcing are in place and are ready for inspection. Keep Architect/Engineer informed of the basic schedule so that he can anticipate inspection times in advance of the required 24-hour notice. Canceled pours are subject to additional inspection charges by the Architect/Engineer against the Contractor where the Architect/Engineer representative is already in route to the site at the time the concrete pour is canceled. Inspection costs shall be based upon the hourly rate of the Architect/Engineer representative plus travel expenses.
2. Do not cast concrete until the Architect/Engineer has observed and accepted the installation.
3. Premature notification of the Architect/Engineer to inspect the reinforcement of forms shall be subject to additional inspection charges by the Architect/Engineer as described above.

END OF SECTION 03 20 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete as shown or implied by the Contract Documents.
2. Concrete requirements for housekeeping pads and inertial isolation slabs.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Concrete Reinforcement

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. 116R – Cement and Concrete Terminology
2. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
3. 211.1 – Standard Practice For Selecting Proportions For Normal, Heavy Weight, And Mass Concrete
4. 211.2 – Standard Practice For Selecting Proportions For Structural Lightweight Concrete
5. 214 – Recommended Practice For Evaluation Of Strength Test Results Of Concrete
6. 301 – Specifications for Structural Concrete
7. 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
8. 305 R – Recommended Practice For Hot Weather Concreting
9. 306 R – Recommended Practice For Cold Weather Concreting
10. 318 – Building Code Requirements For Reinforced Concrete

B. ASTM International (ASTM):

1. C 33 – Standard Specification for Concrete Aggregates
2. C 94 – Standard Specification for Ready-Mixed Concrete
3. C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete
4. C 150 – Standard Specification for Portland Cement
5. C 260 – Standard Specification for Air-Entraining Admixtures for Concrete
6. C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
7. C 330 – Standard Specification for Lightweight Aggregates for Structural Concrete
8. C 494 – Standard Specification for Chemical Admixtures for Concrete
9. C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete

10. D 6 – Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
11. D 297 – Standard Test Methods for Rubber Products-Chemical Analysis
12. D 994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
13. D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
14. E 1155 – Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
15. F609 – Standard Test Methods for static slip resistance of Footwear sole, heel, or related materials by horizontal-pull slipmeter.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers literature for each type of product furnished.
- B. Shop Drawings:
 1. Provide layout drawings for coordination of floor slab pours. Indicate locations of expansion joints, construction joints, and control joints.
- C. Quality Assurance Submittals:
 1. Concrete Mix: Submit proposed concrete mix designs for each strength, slump, and combination of admixtures required for the Project.
 2. Test Reports:
 - a. Submit chloride ion tests or total chloride tests (with generally accepted method to relate total chloride to chloride ion) to show compliance with maximum ion concentrations.
 - 1) Tests may be from another job, utilizing the same proportions of aggregates, cements, and admixtures.
 - b. Submit slump, air-entrainment, compressive strength, and flatness and levelness test reports to the Architect/Engineer.

1.4 QUALITY ASSURANCE

- A. Codes and Standards:
 1. In addition to complying with all pertinent codes and regulations, comply with all pertinent requirements of the following American Concrete Institute Publications:
 - a. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
 - b. ACI 211.1 – Standard Practice For Selecting Proportions For Normal, Heavy Weight, And Mass Concrete

- c. ACI 211.2 – Standard Practice For Selecting Proportions For Structural Lightweight Concrete
 - d. ACI 214 – Recommended Practice For Evaluation Of Strength Test Results Of Concrete
 - e. ACI 305 R – Recommended Practice For Hot Weather Concreting
 - f. ACI 306 R – Recommended Practice For Cold Weather Concreting
 - g. ACI 318 – Building Code Requirements For Reinforced Concrete
 2. Where provisions of pertinent codes and standards conflict with this section of the Project Manual, the more stringent provisions shall govern.
- B. Qualification for Testing:
 1. The following field-testing procedures shall be performed only by personnel holding current certificates issued by ACI for Concrete Field Testing Technician - Grade I as required by the local code.
 - a. Sampling of fresh concrete
 - b. Testing fresh concrete for slump
 - c. Testing fresh concrete for entrained air
 - d. Making concrete specimens for compression tests
 2. Flatness and levelness testing: Floor flatness and levelness testing shall be performed by a technician trained in the use of the testing equipment and the procedures of ASTM E 1155.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section: Project Management and Coordination. Review methods and procedures related to concrete Work, including, but not limited to, the following:
 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review requirements for concrete tolerances, finishing, and curing methods, prior to commencing concrete work
 - a. Include floor covering installers, to review specific tolerance and finish requirements.

1.5 PROJECT CONDITIONS

- A. Environment Conditions:
 1. Extreme temperature conditions:
 - a. When extreme hot or cold weather conditions occur, or are expected to occur, which might detrimentally affect concrete, employ handling and placing techniques to guard against such effects.

- 1) Comply with the ACI nomograph attached to the end of this Section.
 - b. Comply with the recommendations of American Concrete Institute publications ACI 305 R and ACI 306 R, for hot and cold weather concreting.
2. Inclement weather:
- a. Unless adequate protection is provided, do not place exterior concrete during rain, sleet, or snow.
 - b. Do not use calcium chloride or admixtures containing soluble chlorides.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: ASTM C 150, Type I or III
- B. Fine Aggregate: ASTM C 33 with fineness modules, 2.40 to 3.00. For pumped concrete, 15 to 30% passing number 50 sieve and 5 to 10% passing a number 100 sieve.
- C. Coarse Aggregate:
 1. ASTM C 33 with maximum size:
 - a. Three-fourths of minimum clear spacing between reinforcing bars or between bars and forms
 2. Provide crushed stone for sidewalks, curbs, and exterior slabs/stairs
 3. Pea gravel shall not be used as an aggregate for any part of the elevated structure or the foundation system. Pea gravel may be acceptable for miscellaneous structural items as approved by the Architect/Engineer.
- D. Lightweight Aggregate: ASTM C 330.
 1. Nominal maximum size: 3/4"
 2. Pre-soak aggregate prior to mixing in accordance with aggregate supplier recommendations
- E. Water: Clean, fresh, potable.
- F. Air-Entraining Admixture: ASTM C 260
- G. Concrete shall not exceed maximum chloride ion content for corrosion protection as defined in ACI 318 Table 4.4.1.
- H. Fly Ash: ASTM C 618, Class C or F.
 1. Fly ash shall not replace more than 20% of the cement.

I. Curing and Sealing Compounds:

1. Products: Furnish one of the following curing or curing and sealing compounds for each application listed:
 - a. Interior concrete slabs to receive floor coverings or other applied material: ASTM C 309, Type 1D, Class B; water based, all resin, dissipating, VOC compliant, clear with fugitive dye.
 - 1) Conspec Marketing & Manufacturing Co., Inc.; WB Resin Cure
 - 2) Dayton Superior Chemical Division; Day-Chem Rez Cure (J-11-W)
 - 3) L&M Construction Chemicals, Inc.; Cure R
 - 4) W.R. Meadows; 1100 (Clear)
 - b. Interior concrete slabs, finish scheduled as sealed concrete, or formed concrete requiring use of a curing compound: ASTM C 309, Type 1, Class B; water based, all resin, VOC compliant, clear.
 - 1) Dayton Superior Chemical Division; Safe Cure & Seal (J-18)
 - 2) Euclid Chemical Company; Aqua-Cure VOX
 - 3) L&M Construction Chemicals, Inc.; Dress & Seal WB
 - 4) W.R. Meadows; Vocomp
 - 5) BASF Construction Chemicals; Sonneborn; Kure-N-Seal W
 - c. Interior concrete slabs, finish scheduled as hardener/sealer or hardened sealed concrete: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1) Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
 - 2) Curecrete Distribution Inc.; Ashford Formula.
 - 3) Dayton Superior Corporation; Day-Chem Sure Hard.
 - 4) Euclid Chemical Company (The); Euco Diamond Hard.
 - 5) L&M Construction Chemicals, Inc.; Seal Hard.
 - 6) Meadows, W. R., Inc.; Liqui-Hard.
 - 7) Symons Corporation, a Dayton Superior Company; Buff Hard.
 - d. Product used shall be compatible with waterproofing if forms are stripped from concrete to receive waterproofing prior to 7 days curing above 50°F.
 - e. Refer to Part 3 Article "Curing" for removal of curing compounds.
2. If curing compound is not used, and the forms are stripped prior to 7 days curing, the following methods are approved:
 - a. Ponding or continuous sprinkling
 - b. Continuously wet mats
 - c. Sand kept continuously wet

J. Expansion Strips:

1. Self-expanding cork: ASTM D 1752, Type III, preformed, self-expanding strips formed of cork particles with a non-bitumen, isolable resin binder for all interior and exterior slabs at building vertical faces, or as noted.
2. Asphaltic board expansion joint: ASTM D 994, preformed joint material. Material shall not deform under normal handling, or become brittle. Use in exterior slabs, except at building vertical faces or as noted.
3. Closed-cell poly

K. Waterstops:

1. 20 OZ. Copper formed to shapes shown on the drawings.
2. PVC flat ribbed waterstops:
 - a. Manufacturers:
 - 1) Vinylex Corporation
 - 2) Greenstreak.
 - b. Shapes and sizes to be reviewed by the Architect/Engineer.
3. PVC dumbbell waterstops:
 - a. Manufacturers:
 - 1) Vinylex Corporation
 - 2) Greenstreak.
 - b. Shapes and sizes to be reviewed by the Architect/Engineer.
4. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
 - 2) CETCO; Volclay Waterstop-RX.
 - 3) Concrete Sealants Inc.; Con Seal CS-231.
 - 4) Greenstreak; Swellstop.
 - 5) Henry Company, Sealants Division; Hydro-Flex.
 - 6) JP Specialties, Inc.; Earth Shield Type 20.
5. Additional types, shapes, and sizes to fit the job conditions, with review by Architect/Engineer.
 - a. Standard: Vinylex Corporation

L. Joint Sealant:

1. Flatwork: Two-part polysulfide compound
 - a. Standard: "Euco Polysulphide sealant" by the Euclid Chemical Company
 2. Vertical joints: Two-part polysulfide compound
 - a. Standard: W.R. Meadows CM-60
 3. Vertical joints: Two-part polyurethane, refer to Section 07920.
- M. Water Reducing Admixtures:
1. Normal set: ASTM C 494, Type A
 2. Retarders: ASTM C 494, Type D
 3. Accelerators: ASTM C 494, Type C or E
 4. High range water reducers: ASTM C 494, Type F
- N. Crystalline Waterproofing Additive: Concrete waterproofing and protection system shall be of the crystalline type provided in a carrier of cement and sand. Use Bio protection for any concrete walls, lids, or bases which will contain water.
1. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions. Testing shall be performed by an independent laboratory.
 2. Crystalline Formation: Crystallizing capability of waterproofing system shall be evidenced by independent SEM (Scanning Electron Microscope) photographs showing crystalline formations within the concrete matrix at a magnification no greater than 2000 times.
 3. Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD-C48 - Mod "Permeability of Concrete" on maximum 2" thick samples. The treated samples shall exhibit no measurable leakage against control samples which shall exhibit full saturation and measurable leakage. Treated samples shall have an over 95% reduction in permeability.
 4. Crack Healing: Crack healing testing shall have been performed where cracks in the treated panels shall heal within several days and cracks in the non-treated panels shall be shown to continue to pass water at the completion of the 2.5 week test.
 5. Acceptable products:
 - a. Kryton international Inc.: Krystol Internal; Krystol Internal Membrane for Concrete.
 - b. Xypex Chemical Corporation;; Xypex Admixture
 6. Doseage rate: Crystalline dosage as recommended by manufacturer; no less than 2%-3% by weight of cement content.
- O. Evaporation Retardant:

1. Standard: Master Builders Confilm; Degussa Building Systems
2. Apply per manufacturer's directions.

P. Vapor Retarders:

1. Refer to Division 07 Section: Vapor Retarders, or use the information within this section if there is no Specification section which pertains to vapor retarders.
2. Plastic Vapor Barrier: ASTM E 1745, Class A with a permeance of 0.01 as tested before and after mandatory conditioning (ASTM E 1745 Section 7.1 and sub paragraph 7.1.1-7.1.5) less than 0.01 perms (grains/(ft² hr in Hg). Include manufacturer's recommended adhesive or pressure sensitive tape.
 - a. Products:
 - 1) Fortifiber Corporation; Moistop Ultra 15.
 - 2) Reef Industries; Griffolyn G 15.
 - 3) Stego Industries, Stego Wrap 15.

Q. Bond Break:

1. 15 pound per square (100 sq.ft.) building paper

R. Bonding Agent:

1. Select bonding agent to suite the job condition and application.
2. Products:
 - a. Conpro Primer by Conproco Corp.
 - b. SBR Latex by the Euclid Chemical Company.
 - c. Everweld by L&M Construction Chemicals Inc.
3. Apply per manufacturer recommendations.
4. Finished concrete surface shall be roughened and cleaned, prior to application of the bonding agent.

2.2 MIX DESIGNS

A. Normal Weight Concrete:

1. Compressive strength: 4000 PSI.
2. Minimum cement content: 517 pounds per cubic yard (adjust for air entrainment).
3. Water/cement ratio: 0.45 maximum (Typical) 0.40 for concrete exposed to deicing salts, blackish water or salt spray, no water to be added to concrete after plant batching.
4. Slump: 4" + 1", adjust with addition of the admixture for pumping.
5. Typical for slabs unless walls, beams, columns and footing noted otherwise.

B. Air-Entrainment:

1. Provide air entrainment at:

- a. All concrete that is to be exposed to the elements (weather) in the completed structure.
 - b. All concrete in contact with salts.
 2. All other concrete may be air-entrained or non-air-entrained, at the Contractor's option.
 - a. Hard-troweled finishes shall not have air-entrainment.
 3. Percentage of air content shall be determined in accordance with the admixture manufacturer's recommendations, to meet ASTM C173 or ASTM C231, based on aggregate size and a moderate level of exposure.
- C. Selection of Concrete Proportions:
 1. Proportions of materials for concrete shall be established in accordance with Section 5.2 of ACI 318.
 2. Follow ACI 211 and ACI 301 to determine the water-cement ratio for lightweight concrete.
 3. Concrete Mixing:
 - a. Plant mix concrete materials in same proportions as approved concrete mix design in accordance with ACI 304.
 - 1) Incorporate admixtures in quantities and using methods recommended by admixture manufacturers.
 - 2) Incorporate only admixtures included in the approved mix design, or with approval by Architect/Engineer.
 - b. Do not add water to batched concrete without approval by Architect/Engineer.
- D. High Slump Concrete:
 1. Slumps greater than those specified may be used (up to 10") under the following conditions:
 - a. Prior approval has been obtained from the Architect/Engineer, including location of pours and proposed mixes.
 - b. Admixture systems or high range water reducers are used to achieve the high slumps.
 - c. Water-cement ratios are compatible with normal mixes.
 - d. Compressive strength of the concrete exceeds normal mixes at specified slumps.
 - e. If high range water reducers are used, the admixture is added by a concrete technician employed by the concrete supplier.
 2. Submit mix designs to Architect/Engineer for review.
 3. This review is made to ensure that portions of the mix meet the specifications. All performance related criteria must still be met.
- E. Crystalline Waterproofing:

1. Add crystalline waterproofing admixture at a rate of 2-3 percent by weight of portland cement content.
2. Provide in concrete where “integral crystalline waterproofing” or “integral waterproofing” is indicated.

PART 3 - EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that all items to be embedded in concrete are in place.
3. Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

- A. Remove all wood scraps, ice, snow, frost, standing water, and debris from the area in which concrete will be placed.
- B. Thoroughly wet the surface of excavations (except in freezing weather), coat forms with release agent, and remove all standing water.
- C. Thoroughly clean all transporting and handling equipment.
- D. All concrete slabs on grade to be placed on a granular fill. Depth of fill to equal the slab thickness unless otherwise noted.
- E. Substrate over which the vapor barrier will be placed shall be compacted, smooth, and free of glass, large stones, and other objects that might puncture the barrier.

3.3 CONCRETE MIXING

- A. Plant mix concrete materials in same proportions as approved concrete mix design and in accordance with ACI 304.

1. Incorporate admixtures in quantities and using methods recommended by admixture manufacturers.
 2. Incorporate only admixtures included in the approved mix design, or with approval by Architect/Engineer.
- B. Do not add water to batched concrete without approval by Architect/Engineer.

3.4 PLACING CONCRETE

A. Method:

1. Convey concrete from mixer to place of final deposit by methods that will prevent separation and loss of materials.
2. For chuting, pumping, and pneumatically conveying concrete, use only equipment of such size and design as to ensure a practically continuous flow of concrete at the delivery end without loss or separation of materials.
3. Deposit concrete as nearly as possible in its final position to avoid segregation due to re-handling and flowing.
4. Contractor shall use screed poles or similar devices to ensure that all slabs are cast at the proper elevations and that specified tolerances are maintained.
5. Deflections of supporting structure are to be anticipated to produce a level slab.

B. Rate of Placement:

1. Place concrete at such a rate that concrete is at all times plastic and flows readily between reinforcement.
2. When placing is once started, carry it on as a continuous operation until placement of the panel or section is complete.
3. Do not pour a greater area at one time than can be properly finished; this is particularly important during hot or dry weather.

C. Compaction:

1. Thoroughly consolidate all concrete by suitable means during placement, working it around all embedded fixtures and into corners of forms.
2. During placement, thoroughly compact the concrete by hand tamping and by mechanical vibration.

D. Acceptability:

1. Do not use retempered concrete or concrete that has been contaminated by foreign materials.

3.5 LEVELING AND FINISHING

- A. General: Finish concrete in accordance with ACI 301.

B. Finishing Exposed Walls:

1. Remove fins and fill tie holes, honeycombs and air holes (bug holes).
2. Provide a rubbed finish on all interior exposed concrete walls.
3. Provide a smooth rubbed finish on all exposed exterior concrete walls, including site walls.
4. Finishing methods:
 - a. Rubbed finish:
 - 1) Not later than one day after form removal, rub with carborundum brick or another abrasive to remove fins, ridges and other surface irregularities.
 - b. Smooth rubbed finish:
 - 1) Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

C. Finishing Slabs, Flatwork, Walk, Stairs:

1. Trowel all interior slabs to a smooth, hard finish unless otherwise indicated.
 - a. Provide a non-slip finish in all areas subject to public traffic.
2. Surfaces to receive a light broom finish:
 - a. Exterior slabs, walks, stairs
 - b. Interior floors to receive a dry set mortar installation of ceramic tile, tile, or pavers.
 - c. Interior stair treads not scheduled to receive floor covering
3. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.

D. Tolerances:

1. Place concrete so members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 - a. Level Alignment: Variance in elevation of top of slab in any typical structural bay shall not exceed 1/2 inch.
 - b. Structural Steel and composite metal deck structures: Concrete shall be placed in a manner that produces a slab that will meet the specified flatness and levelness tolerances prior to application of any superimposed loads.
2. Floor slabs: Finish floor slabs to meet the following flatness and levelness test requirements.

3. Definitions:

- a. Test surface: The entire floor area on any one building level.
 - b. Test Section: Any subdivision of the test surface measuring no less than 8 feet on a side and no less than 320 square feet.
4. Test Sections less than 8 feet on a side or less than 320 square feet or at slab boundaries, block-outs or other discontinuities excluded by ASTM E 1155: Finish and measure surface so gap at any point between concrete surface and an unlevelled freestanding 10-foot- (3.05-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 1/4 inch.
- a. Finish interior slab surfaces to the following tolerances, measured with a Type II apparatus within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface. Submit report to the Architect/Engineer within 72 hours of concrete placement.
 - 1) Specified overall values of flatness, F_F 30; and levelness, F_L 20; with minimum local values of flatness, F_F 24; and levelness, F_L 15.

3.6 JOINTS

A. Expansion Joints:

1. Provide where indicated on the Contract Documents.
2. Install expansion strips full depth of joints.
3. Where caulking of joints is indicated on Drawings, install fillers to 1/2 inch of top and pour full with sealant.
 - a. Standard: See "Joint Sealant for Flatwork," this section.
4. Provide self-expanding cork at all intersections of exterior concrete and vertical surfaces. Caulk top 1/2 inch of joint.
5. Where asphalt expansion joints are not sealed hold top of asphalt 1/4 inch below abutting concrete. Tool joints on both sides of expansion joint.

B. Tooled Joints:

1. Provide standard tooled joints where indicated on the Contract Documents.
2. Make joints straight, clean, and unragged.
3. Tool concrete on both sides of asphalt pavement.

C. Construction Joints:

1. Joints shall be made with properly constructed bulkheads and include formed keyways.
2. Reinforcing shall extend through all construction joints unless otherwise noted on the Contract Documents.

3. The Contractor shall consult with the Architect/Engineer before starting concrete work to establish a satisfactory placing schedule and to determine the location of construction joints so as to minimize the effects on the floor systems.
4. Horizontal construction joints, other than where shown on the Contract Documents, will not be permitted.
5. Vertical construction joints shall be located between quarter and third points of the spans. Submit construction joint layout for A/E review and approval.
6. If diamond blockouts are used around columns at the slab on grade level, the diamond must be poured to within plus or minus 1/16th of an inch in elevation with respect to the surrounding slab on grade. Floor prep as required to assure the blockout joint does not show through the flooring material.

D. Control Joints:

1. Control joints shall be provided in all slabs on grade unless waived by the Architect/Engineer. Elevated slabs shall not have control joints unless specifically detailed. Joints may not be required under carpet and sheet vinyl floor finishes.
2. Locate as shown on drawings or along column lines and at intervals not exceeding 20 feet in each direction. Review location with A/E prior to pouring slabs.
3. Control joints shall be 1/4 of the slab thickness and shall be sealed in accordance with "Joint Sealant" this section. Saw cut joints within 12 hours of placing the slab.

E. Bond Break:

1. Install where indicated. Lap seams a minimum of 4 inches.

F. Waterstops:

1. Install where indicated.
2. Vinyl waterstop joints shall be chemically or heat welded per manufacturer's recommendations.
 - a. Install waterstop near center of concrete pour, unless otherwise indicated on Drawings.
3. Bentonite waterstops shall be installed in accordance with manufacturer's instructions.
 - a. Provide 3 inches minimum concrete cover.

3.7 CURING

A. Formed Surfaces:

1. Cure formed surfaces by either of the following methods:
 - a. Refer to Division 03 Section "Formwork" for minimum time periods that formwork must remain in place even when curing compound is used.

- b. Leave forms in place until the cumulative number of days or fractions thereof, not necessarily consecutive, has totaled seven days during which the temperature of the air in contact with the concrete is 50°F or above.
- c. Remove forms at an earlier time but apply curing compound to concrete surfaces.
- d. Apply compound in accordance with manufacturer's recommendations.
- e. Do not add curing/sealing compound to walls that receive waterproofing unless a letter has been submitted to the Architect/Engineer, prior to the compound's use, that the specific compounds are compatible with their system.

B. Troweled Finish:

- 1. As soon as surface has dried sufficiently to not be marred by the application, apply sealer/curing compound in accordance with manufacturer's recommendations.
- 2. Do not add curing/sealing compound to walls that receive waterproofing unless a letter has been submitted to Architect/Engineer, prior to the compound's use, that the specific compounds are compatible with their system.
- 3. After application, keep all traffic, tools, materials, and equipment off such treated areas for at least twenty-four hours.
- 4. For floors scheduled as sealed concrete, after all other work in the area has been completed, apply a second coat of sealer/curing compound.

C. Wet Cure:

- 1. Concrete not covered with curing compound should be kept wet for at least 7 days.
- 2. Keep forms continuously wet to prevent the moisture loss until forms are removed.

D. Curing Compound Removal:

- 1. Remove residual curing compound from floor slabs to receive applied finishes using methods recommended by the manufacturer of the curing compound.
- 2. Remove curing compound no earlier than 28 days after application or after structure is enclosed and protected from exterior water sources.
- 3. Wet mop or rinse and wet vacuum slab to remove traces of cleaning products.

E. Hardener/Sealer:

- 1. Apply to wet-cured concrete in accordance with manufacturer's instructions.

3.8 PATCHING AND REPAIR

A. Inspection/Remedial Work:

- 1. Immediately after forms and curing membranes have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holds, and other imperfections before the concrete is thoroughly dry.

B. Patching and Minor Repairs:

1. At all permanently exposed portion of interior concrete formed surfaces, repair surface defects including color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface.
 - a. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth.
 - 1) Make edges of cuts perpendicular to concrete surface.
 - b. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - c. Fill and compact with patching mortar before bonding agent has dried.
 - d. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete durability and structural performance as determined by Architect/Engineer.
 4. Remove all fins, offsets and projections by dry-stoning surfaces which will be exposed in the finished structure or will receive waterproofing or other barrier coating or membrane.
 - a. Provide additional patching of foundation wall for application of waterproofing membrane, in accordance with the manufacturer's recommendations.
 5. Remove or fill all ridges, trowel marks, protrusions or pits more than 1/8-inch diameter on floor slabs by dry-stoning, grinding, or filling with trowelable cementitious underlayment.
- C. Patching of Existing Concrete:
1. Patch in manner to receive new finishes so that existing and patched surfaces are smooth and continuous and have a uniform appearance, using methods specified for patching and repair.
- D. Major Defective Areas:
1. If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Architect/Engineer may require the concrete to be removed and replaced complete in accordance with the provisions of this Section, all at no additional cost to the Owner.

2. Floor slabs that do not meet tolerances specified shall be remediated by the Contractor to the elevation, flatness, or levelness specified at no additional cost to the Owner.
 - a. Contractor shall use floor-leveling materials acceptable to the manufacturer of floor finishes scheduled for the area to be remediated.

3.9 TESTS

A. Testing Laboratory:

1. The owner shall engage the testing agency to conduct the testing for compliance with the requirements of the Project Manual.

B. Compression Tests:

1. Secure minimum five standard cylinders from each pour of concrete, additional five sets of cylinders for every 50 cubic yards of concrete placement of the day, in accordance with ASTM C31, and cure under standard moisture and temperature conditions.
2. From each batch test in accordance with ASTM C39.
3. Test two cylinders at 7 days and two cylinders at 28 days, and save one for additional test, if needed.
4. Submit duplicate tests reports of results from testing to Architect/Engineer.
5. Take steps immediately to evaluate unsatisfactory test results. Test the fifth cylinder.
6. In the event of unsatisfactory test results, an investigation as outlined in Section 5.6.4 of ACI 318-Latest Edition shall be employed.

C. Slump/Air-Entrainment:

1. Perform slump tests in accordance with ASTM C 143.
2. Determine the air content of air-entrained concrete in accordance with ASTM standards.
3. Report results of slump tests on each compression test report, and report whether the concrete represented by the compression tests is air-entrained or nonair-entrained.

D. Floor Profile:

1. Test floor profile in accordance with ASTM E 1155 within 24 hours of floor placement, before shoring is removed.
2. Submit test results to Architect/Engineer within 72 hours of concrete placement.

E. Retesting:

1. Should additional testing be required because of unsatisfactory tests results, the Contractor shall reimburse the owner for the costs incurred for correcting any deficiencies and the costs of any tests.

END OF SECTION 03 30 00

SECTION 03 60 00 — EPOXY GROUT

PART I - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish labor and materials to install epoxy grout as shown or implied by the Contract Documents.
2. Furnish labor and materials necessary to grout anchor bolts and reinforcing bars into existing concrete and to patch existing concrete at equipment anchorages.
3. Furnish labor and materials to patch and repair existing concrete.
4. Furnish labor and materials to repair new construction as required by field errors or omissions.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Concrete Reinforcement

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. Repairing concrete with epoxy grout and epoxy mortars shall conform to all requirements of Standard Specification for Repairing Concrete with Epoxy Mortars (ACI 503.4-Latest Edition), publishing by the American Concrete Institute, Detroit Michigan, except as modified by the requirements of this project specification.

1.3 SUBMITTALS

- A. Before any of the materials of this Section are delivered to the job site, submit product literature to the Architect/ Engineer in accordance with Division 01 Section: Submittal Procedures of these Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Reference Standard: Provide products manufactured by the following:

1. Sika Corporation

2.2 PRODUCTS

- A. Epoxy Grout for Grouting Anchor Bolts or Concrete Patching Mortar (when mixed with recommended aggregate):
1. For overhead installations:
 - a. Sika Corporation; Sikadur 35, Hi-Mod LV
 - b. Simpson Strong-Tie Company, Inc.; FX-763
 - c. BASF Corporation Building Systems; MasterEmaco ADH 327RS
 2. For non-overhead installations:
 - a. Laticrete International, Inc.; Spectralock Pro
 - b. Laticrete International, Inc.; Spectralock 2000 IG
 - c. Sika Corporation; Sikadur 31 Hi-Mod Gel
 3. Adhesive anchors:
 - 1) HIT-RE 500 V3; Hilti Inc.
 - 2) HIT-HY 200; Hilti, Inc.
 - 3) HIT-HY 70; Hilti, Inc.
 - 4) Epcon System; ITW Red Head
 - 5) Pure 110+; Powers Fasteners, Inc.
 4. Due to the large number of different applications and field conditions, additional products may be required by the Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Surface Preparation:
1. Surfaces of existing concrete shall be dry and structurally sound prior to grouting.
 2. The surfaces of concrete at the perimeter of openings, which will be in contact with the grout fill, shall be cleaned. Remove dirt, oil, grease, and other foreign matter.
 3. Apply cleaning agent, lacquer thinner by means which will not allow spillage and dripping on existing facilities below.
 4. Existing steel reinforcing shall be cleaned by wire brush or by sand blasting, or needle gun, with all loose or damaged material removed.

3.2 INSTALLATION

A. Preparation:

1. Form to lines and elevations indicated or required such that adequate anchorage and bearing is provided.

B. Application:

1. Apply grout in accordance with the manufacturer's recommendations. Thoroughly pack forms to minimize shrinkage.
2. Rodding may be required to eliminate voids, honeycombing, and similar defects. Consult manufacturer.
3. Finished installation shall be tight, neat, smooth, and flush with adjoining surfaces and shall be thoroughly bonded thereto.
4. Loose, spalled, cracked, or otherwise defective material will be rejected.
5. Application by trowel is acceptable when forming is impractical or impossible.
6. Notify engineer of proposed method of installation prior to commencement of work.
7. When repairing existing concrete, restore original concrete size and shape with new material.
8. Avoid feathered edges by undercutting edges at sides of patches.
9. Notify engineer of any crack suspected of being a "working joint" prior to patching.

C. Curing:

1. Protect and cure grout in accordance with the manufacturer's recommendations.

END OF SECTION 03 60 00

SECTION 05 05 13 – GALVANIZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: All galvanizing of metals when such coating is specified, except as otherwise shown, specified or required.

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 123 - Specification for Zinc-Coated (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A 153 - Specification for Zinc Coating (Hot-Dip) On Iron and Steel Hardware
3. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
4. ASTM A 385 - Practice for Providing High-Quality Zinc-Coatings (Hot-Dip)
5. ASTM A 392 - Specification for Zinc-Coated Steel Chain-Link Fence Fabric
6. ASTM A 53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
7. ASTM A 121 - Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
8. ASTM A 143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
9. ASTM A 384 - Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanization of Steel Assemblies
10. ASTM B 6 - Specification for Zinc (Slab Zinc)

11. MIL-P-21035B - Paint High Zinc Dust Content, Galvanizing Repair
12. MIL-P-26915C - Primer Coating Zinc Dust Pigmented for Steel Surfaces

PART 2 PRODUCTS

2.1 MATERIALS

- A. Standard: Meet the requirements of ASTM B 6 and "Prime Western" grade, or equal, for zinc for galvanizing, zinc coating or plating.

PART 3 EXECUTION

3.1 PREPARATION

- A. General: Blast clean or grind smooth wrought metals and castings. Tumble and grind flush all high spots when a smooth coat is required for castings. Normalize castings to prevent cracking.

- B. Base Metal Cleaning: Thoroughly clean base metal. Remove all welding slag and burrs. Remove surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation, by blast cleaning, by immersion in a caustic bath, acid pickle and flux or other approved method.

- C. Product Preparation: Fabricate structural steel products and assemblies to be galvanized in accordance with ASTM A 143, A 384, A385 and Class I guidelines as shown in "Recommended Details of Galvanized Structures" as published by American Hot-Dip Galvanizers Association, Inc.

3.2 APPLICATION

- A. Hot Dip: Use the hot-dip process for galvanizing as required by the appropriate ASTM and American Hot-Dip Galvanizers Association, Inc. specifications.

1. Do not allow the dipping to come in contact with or rest upon the dross during the operation.
2. Do not use procedures tending to agitate the dross.

- B. Required Facilities: Perform the galvanizing and coating in a plant having the required facilities to produce the quality of coatings specified and with ample capacity for the volume of work required. Handle and ship galvanized material in a manner which will avoid damage to the zinc coating.

C. Requirements: Perform galvanizing in accordance with the requirements of the following specifications:

| <u>Item</u> | <u>ASTM</u> |
|-----------------------------------|----------------|
| 1. Iron and steel products | A 123 |
| 2. Iron and steel hardware | A 153 |
| 3. Chain for chainwheel operators | A 153 |
| 4. Chainwheels and Guides | A 123 |
| 5. Steel sheets | A 924 |
| 6. Assembled products | A 385 & A 123 |
| 7. Steel chain link fence fabric | A 392 Class II |
| 8. Steel pipe | A 53 |
| 9. Steel barbed wire | A 121 |

3.3 INSTALLATION

A. Field Coating for Touch-Up: Coat all field welds, abraided areas where damage is more than 3/16-inch wide or uncoated cut edges in material more than 1/10-inch thick with an organic zinc-rich paint complying with MIL-P-21035B or MIL-P-26915C in multiple coats to dry film thickness of 8 mils.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 05 50 00— METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Ornamental light iron, steel, aluminum and stainless steel items, including nosings, ladders, safety posts, thresholds, anchors, bolts and accessories required for the attachment of items specified herein, and other items shown, to complete the Work in accordance with the Contract Documents.

B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:

1. Section 03 30 00 – Reinforced Cast-In-Place Concrete
2. Section 05 52 00 - Handrails and Railings
3. Section 08 11 16 - Aluminum Doors and Frames
4. Section 09 96 00 - High Performance Coatings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 36/A36 - Structural Steel
2. ASTM A 193/A193M
Grade MT316 - Stainless Steel Bolts
3. ASTM A 283/A283M - Low and Intermediate Tensile Strength
Carbon Steel Plates, Shapes and Bars
4. ASTM A 554 - Welded Stainless Steel Mechanical Tubing
5. ASTM B 137 - Method for Measurement of Mass of Coating on
Anodically Coated Aluminum
6. ASTM B 244 - Method for Measurement of Thickness of Anodic
Coatings on Aluminum and Other Nonconductive Coatings on Nonmagnetic
Basic Metals with Eddy-Current Instruments
7. FS FF-S-325 - Expansion Shields for Masonry Anchorage
8. FS FF-B-588 - Toggle Bolts

9. ANSI A14.3 - Safety Requirements for Fixed Ladders

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Certification: Submit certificates in triplicate for anodic treatment of aluminum. Certificates shall be properly attested by the aluminum fabricator stating that the aluminum has been treated as herein specified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Nonslip nosings for interior concrete stairs
 - a. Wooster Products, Inc., Wooster, OH
 - b. Safe-T-Metal Company, Inc. Style Ax., Garden City Park, NY
2. Ladder Safety Post
 - a. The Bilco Company, New Haven, CT, Model 2 Ladder Up
3. Ladder Rungs
 - a. Safe-T-Metal Co., Inc. Style LR
4. Thresholds
 - a. Wooster Products, Inc., Wooster, OH, Type 115S - Exterior
115 - Interior

2.2 MATERIALS

A. Standards: Provide metal items meeting the requirements of the following standards:

1. Structural steel, shapes and plates, except plates to be bent or cold-formed ASTM A 36/A36M

| | | |
|-----|--|--|
| 2. | Steel plates, bent or cold-formed | ASTM A 283/A283M, Grade C |
| 3. | Steel bars and bar size shapes | ASTM A 36/A36M |
| 4. | Sheet aluminum and extrusions | As required for color (3003 Alloy with mill finish) |
| 5. | Aluminum castings thresholds and the like ornamental | Alloy 356-T6 Alloy 214-F |
| 6. | Aluminum screw machine parts | Alloy 2024-T4 |
| 7. | Structural aluminum | Alloy 6061-T6 |
| 8. | Aluminum bar | Alloy 6061-T6511 |
| 9. | Stainless steel sheet | U.S. Steel 16-10, Grade MT316 |
| 10. | Pipe, stainless steel | ASTM A 554 Grade MT304 |
| 11. | Bolts: stainless steel | ASTM A 193/A193M, Grade MT316 85 percent copper, 5 percent lead, tin and zinc, unless otherwise specified |

12. Provide steel which is to be hot-dip galvanized after fabrication, that has a silicone content in the range of 0 to 0.04 percent or 0.15 percent to 0.25 percent unless otherwise approved.

13. Provide lead expansion anchors for concrete meeting the requirements of FS FF-S-325, wedge type, Group II, Type 4, Class 1 or 2; self-drilling type, Group III, Type I or nondrilling type, Group VIII, Type 1 or 2.

14. Provide bolt anchor expansion shields for masonry meeting the requirements of FS FF-S-325, lag shield type, Group II, Type I, or split shield type, Group II, Type 3, Class 3.

15. Provide expansion bolts of Grade 316MT stainless steel.

16. Provide gauges specified to refer to U.S. Standard gauge for sheet steel, plate iron and steel, and to Brown & Sharp Gauge for wire and sheet aluminum.

17. Provide stainless steel screws, bolts, nuts and similar items used in connection with galvanized exterior Work.

18. Anodically treat aluminum to meet the test requirements of ASTM B 137 for weight and ASTM B 244 for thickness.

B. Nosings: Provide nonslip nosings on all interior stairs, that are 4 inches wide and 6 inches less in length than the length of the tread and of cast abrasive aluminum No. 101. Finish the top surface flush with the cement finish. Install nonslip nosings at the edge of each interior stair landing and platform. Provide a minimum of three anchors to each nosing.

C. Ladders: Provide ladders made of aluminum bar rails 2-1/2 inches by 1/2-inch as shown. Space rungs uniformly and at not more than on 12-inch centers. Provide flat top rungs with serrated abrasive surface. Provide ladders that comply with the latest edition of OSHA and ANSI A14.3 requirements.

1. Secure ladders to concrete or masonry walls and stiffen with aluminum brackets. Fasten to concrete or masonry with stainless steel expansion bolts, unless otherwise indicated. Weld connections between brackets and rails of ladders.

2. Construct protective cages of aluminum as shown.

D. Ladder Safety Post: Install a ladder safety post at the top of all fixed ladders and cast-in ladder rungs below floor and sidewalk doors and roof hatches. Provide the device manufactured of high-strength galvanized steel and include a telescoping section that locks automatically when fully extended. Control upward and downward movement by a spring balancing mechanism with the spring of a special corrosion-resistant alloy. Assemble the unit completely and install it in strict accordance with the manufacturer's instruction. Coat contact surfaces between dissimilar metals as specified in Section 09 96 00.

E. Thresholds: Provide thresholds for door openings of cast abrasive aluminum, and extruded aluminum, unless otherwise shown or specified. Provide 5-inch wide thresholds of the types indicated. Make thresholds the full width of door openings, ends notched to fit the door jambs, and secured to the concrete base with lead expansion shields and stainless steel bolts.

F. Aluminum Finishes: Provide aluminum finishes specified below in strict compliance with the National Association of Architectural Metal Manufacturers (NAAMM) aluminum finish designations, unless otherwise indicated or specified.

1. Provide miscellaneous aluminum angles and cover moldings which are indicated to be painted with a mill finish.

2. Provide aluminum finishes as follows:

- a. Exterior aluminum items, unless otherwise specified: NAAMM Architectural Class 1, AA-A41 clear coating

b. Interior aluminum items, unless otherwise specified: NAAMM Architectural Class 2, AA-A31 clear coating

G. Stainless Steel Finish: Provide stainless steel with a No. 4 satin finish unless otherwise shown.

H. Galvanizing: Galvanize in accordance with Section 05 05 13.

I. Painting: Metal fabrications shall be shop painted in accordance with Section 09 96 00.

2.3 FABRICATION

A. General: Form all Work true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, and free from defects impairing strength or durability. Precision fitting and jointings are required for all Work. Perform all welding in a way to prevent pitting or discoloration.

B. Welding: Weld joints of such character and assemble so that they will be as strong and rigid as the adjoining section. Select wire for welding to prevent discoloration and to insure sound structural welds. Continuously weld exposed joints their entire length unless otherwise shown or specified. Provide all exposed welded face joints dressed flush and smooth.

C. Surface Flaws: Remove surface flaws on aluminum before the anodic coating is applied.

D. Structural Steel: Provide structural steel plates, shapes, bars, sheets and other metal items meeting the requirements of Section 05 12 00.

E. Miscellaneous: Perform all drilling, tapping, cutouts, and reinforcement required to attach, insert or fit thereto, fixtures and fittings in accordance with the drawings templates or instruction for the fixtures and fittings. Do not begin fabrication of metalwork until all drawings, templates or instructions are available.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install metal fabrications in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

B. Alignment: Install all items and set plumb, square, level and true at their proper elevation and plane, and located in true alignment with all Work.

C. Fastening: Securely anchor, ready for operation in every respect. Unless indicated otherwise, fasten metalwork to solid masonry and concrete with expansion bolts and to void areas of unit masonry with toggle bolts.

D. Examine metal Work after installation, painting and glazing have been completed as required. Adjust, repair and replace metalwork as required. Clean and retouch exposed surfaces of metal Work where necessary to bring the color of the finished surfaces reasonably uniform and free from scratches and other surface blemishes.

END OF SECTION 05 50 00 METAL FABRICATIONS

SECTION 05 51 00 – METAL STAIRS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Treads, risers, steel and aluminum structural framing members for stairs, platforms, and anchorage.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 09 96 00 - High Performance Coatings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 50/A50M - Structural Steel
2. ASTM A 193/A193M - Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
3. ASTM B 308/B308M - Aluminum - Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded
4. AWS D1.1 - Structural Welding Code – Steel
5. AWS D1.2 - Structural Welding Code – Aluminum
6. FF-5325 - Expansion Shields

1.3 DESIGN REQUIREMENTS

A. Fabricate the aluminum and steel stairs to support a live load of 150 pounds per square foot with a deflection of the stringers or landing framing not to exceed L/240 of the span.

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Shop Drawings: Submit shop drawings for approval, indicating all the sizes and shapes of the stringers, headers, tees, carrier angles, clip angles, cast treads, landing platforms, bracing, stiffeners, hangers, supports, fascias and anchors as required.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Stair Treads

- a. Wooster Products, Inc.; Type 105
- b. Safe-T Metal Co., Inc.; Type KK

2. Stile and Ships Ladder Treads

- a. Wooster Products, Inc.; Type 106A
- b. Safe-T Metal Co., Inc.; Type D1

3. Platforms

- a. Wooster Products, Inc.
- b. Safe-T Metal Co., Inc.

2.2 MATERIALS

A. Steel Sections: Provide ASTM A 50/A50M steel sections including: stringers, headers, tees, carrier angles, clip angles, angles, bracing, stiffeners, supports, and bearing plates in sizes shown.

B. Aluminum Sections: Provide ASTM B 308/B308M aluminum sections including: stringers, headers, tees, carrier angles, clip angles and angles, bracing, stiffeners, supports and bearing plates, in sizes as shown.

C. Aluminum Plates: Provide ASTM B 209 aluminum riser.

D. Stair Treads: Provide stair treads of abrasive cast aluminum, in width and length as shown and of thickness recommended by the manufacturer for the required length.

E. Stair Platforms and Landings: Provide stair platforms and landings of abrasive cast aluminum, with truss ribs, and toeplates and nosings, matching the treads, as specified.

F. Welding Materials: Provide AWS D1.1 and D1.2 welding for type required for materials being welded.

G. Expansion Bolts: Provide ASTM A 193/A193M expansion bolts with washers and nuts, stainless steel type.

2.3 FABRICATION

A. General: Fit and shop assembly the stairs in the largest practical sections for delivery to the job site.

B. Stringers: Miter the stringers at changes in direction with joints tightly fitted and secured by continuous welds. Grind all exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight. Ease exposed edges to a small uniform radius.

1. Close and fit the ends of stringers at the floor or landing to the floor surface. On landings and platforms where they are part of the stair framing, carry the wall stringers around and above the finished level of the platform to form a base of the height as shown.

C. Treads: Fasten treads for stairs to steel carrier angles, welded to steel stringers.

D. Fasteners: Use Type MT 316 stainless steel complying with ASTM A 193/A193M for fastening treads to the carrier angles and for expansion bolts. Provide closed-end, bottom bearing expansion shields in accordance with the requirements of FF-B-5325.

2.4 FINISHES

A. Surface Preparation: Prepare surfaces to be primed and painted in accordance with Section 09 96 00.

B. Dissimilar Materials: Coat aluminum in contact with dissimilar metals, masonry or lime products, in accordance with Section 09 96 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Cleaning: Clean and strip primed steel items to bare metal, where site welding is required.

3.2 INSTALLATION

- A. General: Install metal stairs in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Alignment: Install and set plumb, square, level and true the stairs, ships ladders and stiles at their proper elevation and plane, and located in true alignment with all the Work.
- C. Fastening: Securely bolt the stairs, ships ladders, platforms and stiles to, or hang from, the structural framing with approved anchors, struts, or hangers.
- D. Alignment: Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- E. Welding: Field weld components indicated on the shop drawings. Perform field welding to meet AWS D1.1 or D1.2.

END OF SECTION

SECTION 05 52 00 – HANDRAILS AND RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: (Stainless steel), (aluminum) welded railings and handrails, anchors, bolts, sleeves and accessories.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 04 20 00 - Masonry

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM B 241/B241M - Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
2. ASTM A 554 - Specification for Welded Stainless Steel Mechanical Tubing

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Fabricate and install the railing or handrail assembly as shown. Space posts not to exceed (4 feet 6 inches) (6 feet) on center.

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Samples: Submit three samples of handrail and post intersection indicating welded connection and finish.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify with field measurements the locations of all sleeves prior to fabrication of pipe railings and posts.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Quick setting grout compound

- a. Quik-Rod, by Preld Industries, Ltd., Plainview, NY
- b. Pol-Rok, by the Hallemite Mfg. Co., Cleveland, OH

2.2 MATERIALS

A. Construction: Fabricate stainless steel railings and posts of nominal 1-1/2-inch Schedule 5 stainless steel pipe conforming to ASTM A 554-MT316. Reinforce stainless steel posts at the base with a 24-inch 1-1/4-inch O.D. Schedule 80 carbon steel pipe as shown. Fabricate aluminum railings and posts of 1-1/2-inch Schedule 40 aluminum pipe conforming to ASTM B 241/B241M, 6063-T6. Reinforce aluminum end posts with Type 6061-T6 aluminum bars 24-inches long.

B. Sleeves: Provide sleeves for posts of nominal sizes indicated and of stainless steel pipe conforming to ASTM A 554, Grade MT-304.

C. Fastening Accessories: Provide 3/16-inch trade size chains of Type (___) (___) 316 stainless steel electrically welded. Provide open-eye swivel snaps, eye bolts and accessories for fastening of stainless steel with a minimum working load limit of 230 pounds.

D. Finish: Finish stainless steel pipe with a 180-grit finish. Finish exterior and interior aluminum pipe railings with a NAAMM Architectural Class I AA-A41 clear coating.

2.3 FABRICATION

A. General: Fit and shop assemble components in the largest practical sizes for delivery to the site. Provide removable sections where shown and provide for expansion and contraction.

B. Exposed Joints: Grind exposed joints flush and smooth with adjacent finish surfaces. Make exposed joints such that they are butt tight, flush and hairline. Ease exposed edges to small uniform radius.

C. Posts: Corner posts will not be allowed. Set back post as shown.

D. Bends and Splices: Where practical, make bends in pipe without the use of fittings. Do not exceed a spacing of 20 feet between railing splices. Fabricate railings and posts in the same plane with continuous 360-degree welds at all intersections.

E. Handrail: Provide single rail handrails turned 90 degrees to terminate 1/8-inch from walls. Provide manufactured brackets made of (1-1/2-inch stainless steel) (1-1/2-inch aluminum) pipe welded to a (stainless steel) (aluminum) flange plate secured to the wall with two stainless steel expansion bolts. Grout hollow walls solid at attachment locations in accordance with Section 04 20 00. Mount terminal brackets not more than 12 inches from the end of the handrails.

F. Protection: Deliver railings to the job site protected in polyethylene tubing with a minimum wall thickness of 0.05 inches. Remove tubing after construction has been completed and when directed.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install handrails and railings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

B. Erection: Recess and set railing posts with quick-setting grout compound into pipe sleeves. Install railing posts required to be anchored to vertical concrete surfaces, with a 6- by 6- by 1/4-inch thick (stainless steel) (aluminum) plate fastened with four stainless steel anchor bolts 5/8-inches in diameter. Close the bottom of the posts with a welded cap. Anchor railing posts to the top flange of stair stringers, with a 3/8-inch thick (stainless steel) (aluminum) plate of the profile and size shown welded to the bottom of the post and fastened to the stringer with two stainless steel 1/2-inch diameter bolts. Grout hollow walls solid at points of attachment as specified in Section 04 20 00.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Furnish the services of a qualified representative of the railing manufacturer to supervise and inspect the railing installation.

END OF SECTION 05 52 00

(NO TEXT FOR THIS PAGE)

SECTION 05 53 00 – METAL FLOOR GRATING AND PLATE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Metal floor grating and plate, supporting angles, and appurtenances.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 05 05 13 - Galvanizing
2. Section 09 96 00 - High Performance Coatings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 36/A36M - Specification for Carbon Structural Steel

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Fabricate grating and plate in accordance with the details shown, designed for a live load of not less than 150 pounds per square foot with deflection not exceeding 1/360 of the span.

1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. CONTRACTOR's Drawings: Submit completely detailed working drawings of all grating and plate for approval before any fabrication is started.
- C. Literature: Submit manufacturer's literature, including load, span and deflection tables for floor grating and plate.
- D. Samples: Submit samples of each type of floor grating and plate to be used.
- E. Welder Certification: Submit reports that confirm that all welders have been certified within the last year by a nationally recognized laboratory, to make groove and fillet welds in all positions.

1.5 QUALIFICATIONS

A. Engage a professional structural engineer, experienced in design of floor grating and plate and licensed in the State of Indiana, to design and seal the floor grating and plate.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

1. Dumping or dropping from trucks is not permitted. Return all bent or damaged sections to the fabrication shop and supply new pieces.

2. Store and cover materials on skids or platforms, above ground in areas set aside for such use.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Use grating or plate of the same type which is the product of the same manufacturer.

1. IKG Border
2. Klemp Corporation

2.2 MATERIALS

A. Metal Grating and Plate: Provide metal grating and plate as shown and specified.

1. Construct aluminum grating and plate of Aluminum Alloy 6061-T6, and supporting angles and appurtenances of Aluminum Alloy 6063-T6.

2. Construct steel grating and plate of ASTM A 36 steel along with appurtenances. All steel shall be galvanized in accordance with Section 05 05 13.

3. Supply supporting angles and appurtenances for steel grating and plate of galvanized, ASTM A 36 steel in accordance with Section 05 12 00.

B. Metal Plate: Provide plate of the raised lug, diamond pattern type. Use a minimum thickness of 3/8-inch and reinforce as shown or required.

2.3 FABRICATION

A. General: Accurately fabricate grating and plate free from warps, twists or other defects which affect appearance and serviceability.

1. Provide grating and plate having a permanent, nonskid pattern on the upper surface.

2. Provide holes where required for passage of pipes, gate stems, or for other purposes. Reinforce all openings to preserve strength.

3. Design grating and plate as individual sections and install for ready removal and replacement. Provide clearance at the ends or between sections of grating of a maximum of 1/4-inch.

B. Parallel Bar Grating:

1. Use grating of the pressure locked parallel bar type.

2. Use grating comprised of parallel bearing bars, at least 3/16- inch thick and 1-1/2 inches deep, with clear spacing of not more than 1-inch, tied securely with transverse bars not less than 1/8-inch thick and 5/8-inch in depth, spaced not more than 2 inches on center or other approved equivalent rectangular pattern fabricated from separate straight bearing bars and tying cross members.

3. At the ends of grating, provide transverse bars not more than 1-1/4 inches from the ends of the bearing bars.

4. Band openings in, and ends of all grating with bars 3/16-inch thick. At the ends of all grating keep the bottom of the band 1/4-inch above the bottom of the grating. Elsewhere provide the bands the same depth as the grating. Weld bands to all intersecting members.

PART 3 EXECUTION

3.1 PREPARATION

A. Field Check: Check all dimensions in the field after all concrete, piping, and equipment are in place to determine the exact dimensions and locations of openings and cutouts. Verify that opening sizes and dimensional tolerances are acceptable and that supports and anchors are correctly positioned.

3.2 ERECTION

A. Grating: Neatly fit adjacent units together and form their transverse members into an uninterrupted straight line. Provide fasteners for each section of grating, anchoring the grating to the supporting angles. Do not extend fasteners above the top plane of the grating.

B. Plate: Provide fasteners or hinges, as required and neatly fit adjacent units together. Do not extend fasteners above the top plane of the plate.

C. Supports: Erect grating in place on supporting angles, as shown, and provide a full and uniform bearing on the supports, precluding any rocking movement. Fit adjacent and transverse units to neatly form an uninterrupted straight line. Do not use wedges or similar shimming devices. Lock securely in place with approved clamps or devices all individual grating panels and plate.

3.3 PAINTING

A. Aluminum Surfaces: Paint aluminum surfaces in which will be in contact with concrete as specified in Section 09 96 00.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 05 56 00 – METAL CASTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Miscellaneous ferrous and nonferrous castings.

1. This classification includes wheel guards, valve boxes, manhole frames and covers, manhole steps, catch basin inlets and covers, curb inlets, stop plank grooves, brackets and supports for piping, gutter inlets, roof and floor drains, cleanouts, trench drain frames and grates, water meter box covers, slide plate grooves, electrical castings, and special malleable iron castings and inserts.

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

- | | | |
|----|------------------|---|
| 1. | AASHTO M306 | - Standard Specification for Drainage Structure Castings |
| 2. | ASTM A 27/A27M | - Specification for Steel Castings, Carbon for General Applications |
| 3. | ASTM A 47 | - Specification for Ferric Malleable Iron Castings |
| 4. | ASTM A 48 | - Specifications for Gray Cast Iron Castings |
| 5. | ASTM A 148/A148M | - Specifications for Steel Castings |
| 6. | ASTM A 536 | - Specifications for Ductile Iron Castings |
| 7. | ASTM B 26/B26M | - Aluminum Alloy Sand Castings |
| 8. | ASTM B 148 | - Aluminum Bronze Sand Castings |
| 9. | ASTM B 584 | - Manganese Bronze |

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. East Jordan Iron Works
2. Neenah Foundry Company
3. U.S. Foundry

2.2 MATERIALS

- A. Conform gray iron castings to ASTM A 48 Grade 35B.
- B. Conform ductile iron castings to ASTM A 536 Grade 65-45-12.
- C. Conform aluminum alloy castings to ASTM B 26 Alloy 356.0 T6.

2.3 FABRICATION

A. Provide castings of uniform quality and free of sand holes, gas holes, shrinkage cracks and other surface defects. Accurately make drainage structure castings to meet the tolerances in AASHTO M306 Section 4.2. Plane or grind castings to secure flat and true surfaces. Make allowance in the patterns so that the specified thickness is not reduced. Provide manhole covers which conform to the details shown and which are true and seat at all points. Do not provide defective castings that have been plugged or welded. Supply castings showing the name of the manufacturer, the country of manufacture, ASTM material designation, individual part number, and cast or heat date. Mark pairs of machined castings to facilitate subsequent identification during installation. Do not paint castings.

B. Cast manhole covers with a checkered top design.

1. Provide water manhole covers with the word "WATER" cast in the center.
2. Provide sanitary and combined sewer manhole covers with the words "SANITARY SEWER" cast in the center.
3. Provide storm sewer manhole covers with the words "STORM SEWER" cast in the center.
4. Provide electrical manhole covers with the word "ELECTRICAL" cast in the center.

2.4 SOURCE QUALITY CONTROL

- A. Load Test: Proof load test the first article of each traffic service casting in accordance with the method and procedure outlined in AASHTO M306, Section 7.0. Maintain test results at the foundry for 7 years. Furnish the results of the proof load tests upon request.
- B. Weight: Reject castings with a weight which is less than the theoretical weight based on required dimensions by more than 5 percent. Provide facilities at the site for weighing castings, or furnish invoices showing true weights, certified by the supplier.
- C. Certification: Furnish a foundry certification stating that samples representing each lot have been tested, inspected, and are in accordance with this specification.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Erect all castings to accurate grades and alignment, and when placing in concrete carefully support castings to prevent movement during concreting.

3.2 PAINTING

- A. Clean metal castings thoroughly before painting. Give manhole frames and covers and valve boxes one coat of primer and two coats of an approved asphaltum varnish or other approved coating at the point of manufacture. Deliver all other castings to the jobsite unpainted. Paint castings as specified in Section 09 96 00.

END OF SECTION 05 56 00

(NO TEXT FOR THIS PAGE)

SECTION 06 05 00 – TIMBER AND LUMBER

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Timber and lumber materials used for structural purposes, graded in accordance with ASTM D 245. Fabricate, erect, and install timber and lumber in accordance with the recommendations of the National Design Specifications for wood construction of the National Forest Products Association. Timber and lumber uses under this Section include structural lumber decking and supports, temporary and permanent sheeting, shoring, bracing, baffles, stop logs, and stop gates. For other uses, use lumber of the kind and grade shown or specified.

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D 245 Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber

1.3 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

B. Handling and Storing: Carefully handle all timber and lumber to avoid splitting or damage to the surfaces and edges and store all timber and lumber in piles at least 1 foot above dry ground and placed to shed water and prevent distortion and warping. Open-stack untreated lumber; close-stack treated lumber. Protect lumber piles from the weather.

PART 2 PRODUCT

2.1 MANUFACTURER

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent product may be submitted.

1. Wax Emulsion Seals:
 - a. Anchorseal by U-C Coatings Corporation

2.2 STRUCTURAL LUMBER

A. General: Provide structural lumber of Douglas Fir-Larch, Southern Pine or Redwood unless otherwise shown or specified.

NOTE: Tabulated bending stresses as indicated in "National Forest Products Association - Supplement to the 1991 Edition shall be modified by the appropriate adjustment factors that apply to the conditions of usage.

B. Grading: Use structural lumber of the following minimum grades unless otherwise shown or specified:

| | <u>Minimum Grade</u> |
|--|------------------------|
| Light Framing and Joists and Planks | No. 1 |
| Beams and Stringers, and Posts and Timbers | |
| Douglas Fir-Larch | No. 1 |
| Southern Pine | No. 1 SR |
| Redwood | Clear Heart Structural |

1. Grade materials in accordance with the rules of the following Agencies:

Douglas Fir-Larch:

West Coast Lumber Inspection Bureau
Western Wood Products Association
National Lumber Grades Authority (Canada)

Southern Pine:

Southern Pine Inspection Bureau

Redwood:

Redwood Inspection Service

2. Meet the requirements of the above grades throughout the entire length of each piece.

2.3 TREATED TIMBER AND LUMBER

A. Impregnate Southern Yellow Pine timber and lumber to be treated with water-borne preservatives conforming to AWPAs Preservative Standard P-5, CCA Type C. Impregnate Douglas Fir-Larch timber and lumber to be treated with water-borne preservatives conforming to AWPAs Preservative Standard P-5 ACZA. Apply the preservative

in a closed cylinder by pressure process - full cell method in accordance with AWWA Product Standard C2. Ensure the minimum net retention is 0.40 pounds per cubic foot.

- B. Manufactures Trade Names for CCA Type C:
Osmose Wood Preserving, Inc., Griffin, GA-CCA Type C Wood Preservative
Hickson Corporation – Wolmanized Pressure Treated
- C. Manufacturers Trade Name for ACZA
J. H. Baxter & Co. - Chemonite

2.4 BAFFLES AND STOP LOGS

- A. General: Construct baffles and stop logs in contact with potable water of untreated lumber unless otherwise specified. Baffles and stop logs not in contact with potable water may be constructed of either treated or untreated lumber.
- B. Treated Lumber: Use treated lumber baffles and stop logs made of Douglas Fir-Larch or Southern Pine as specified for structural lumber, and treat as specified.
- C. Untreated Lumber: Construct untreated lumber baffles and stop logs of clear, heart structural redwood lumber having a minimum of four growth rings per inch. Do not furnish pieces containing sapwood. Surface the lumber smooth on four sides.
- D. Sealing: Seal the ends of green lumber with a wax emulsion.

2.5 SHEETING

- A. General: For wood sheeting which is to be part of the permanent structure, use tongue and groove structural lumber, unless Wakefield sheet piling or lap joint sheet piling is shown. All permanent sheeting shall be treated in accordance with Section 2.3.
- B. Tongue and Groove Sheet Piling: Provide tongue and groove sheet piling with tongues and grooves of ample proportions cut from the solid material.
- C. Lap Joint Sheet Piling: Provide lap joint sheet piling made up of two thicknesses of material securely spiked or bolted together with the two thicknesses overlapping at least one-third the width of the boards so that the sheeting in place consists of two thicknesses throughout with broken joints.
- D. Wakefield Sheet Piling: Provide Wakefield sheet piling consisting of three thicknesses of material securely spiked or bolted together with the center board offset a distance of 2 inches to form a tongue and groove on opposite edges of the sheet pile.

E. Wood Lagging: Provide treated structural lumber for wood lagging which will be a part of the permanent structure.

F. Tight Joint: Provide corners for any type of sheeting built up in a manner to provide a reasonably tight joint.

G. Driving Piles: Sharpen timber sheet piles in a manner which will assist in holding them in true alignment during driving and protect the tops with caps or other means to prevent damage by the driving equipment. Remove and replace any pieces damaged or split below the point of cutoff with undamaged pieces.

H. Temporary Structure Sheeting: Wood sheeting which is not to become part of the permanent structure may be new or used lumber of any species or grade approved and suitable for the proposed use. Approval of such sheeting does not eliminate the requirement for full responsibility for the adequacy of the sheeting.

PART 3 EXECUTION

3.1 PREPARATION

A. Cutting and Boring: Cut and frame all timber and lumber true and exact to a close fit in such a manner that the joints will have an even bearing over the entire contact surfaces. Drive nails and spikes to set the heads flush with the surface of the wood, unless specified otherwise. Deep or frequent hammer marks in surfaces and edges of timbers are not allowed. Perform all cutting and boring of treated timber before treatment. Temporary bolting, spiking, or nailing of treated lumber is not permitted.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Wood centers, furring, grounds, blocking, nailers, temporary protection of all kinds, and all accessories and appurtenances required for the Work.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 05 05 13 - Galvanizing

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

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

2. FS TT-W-571 - Wood Preservation Treating Practices

3. AWWA - American Wood Preservers Association - Type A, Interior Fire Retardant Treated Lumber and Plywood

4. NFPA - National Forest Products Association, National Design Specification for Wood Construction

1.3 SUBMITTALS

A. General: Provide all submittals, including the following as specified in Division 1.

B. Certification: Submit certificates of compliance for preservative treated lumber, fire retardant treated lumber and lumber grades.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

B. Storage and Protection: Store lumber indoors at the site on raised platforms. If outdoor storage is temporarily incorporated, set the material on raised platforms and cover with suitable weatherproof protective coverings, such as tarpaulins or heavy polyethylene film. Battened down covers with sufficient weights, ties or anchors to prevent blowoffs.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Provide lumber for rough carpentry such as nailers, grounds, blocking and framing of Construction Grade, thoroughly seasoned dry No. 1 white fir, ponderosa pine, spruce or hem-fir.

B. Preservative Treatment: Pressure treat all lumber for rough carpentry which is incorporated into the finished structures. Provide pressure-treated lumber complying with the requirements established in the latest AWP A P5 and TT-W-571. Use water-borne preservative with 0.40 percent retentage. Brand all lumber accordingly.

C. Fire Retardant Treatment: Pressure-impregnate all wood designated to be fire-retardant treated with a flameproofing complying with the requirements of AWP A Type A and with U.L., Inc. requirements for flame spread of 25 or less with no evidence of significant progressive combustion when tested in accordance with ASTM E 84. Provide each piece of wood bearing the U.L., Inc. FRS Label or the U.L., Inc. label indicating complete compliance with the fire hazard classification.

D. Code Conformance: Unless otherwise indicated, provide materials conforming to the requirements of the National Design Specification for Stress Grade Lumber as recommended by the National Forest Products Association.

E. Product Standards: Provide plywood conforming to the requirements of the American Plywood Association.

F. Grading: Provide each panel of plywood identified with the appropriate DFPA grade mark of the American Plywood Association.

G. Exterior Plywood Uses: Provide exterior type plywood where plywood used for roof sheathing or decking or in areas where it may be exposed to moisture.

H. Temporary Protection: Provide an exterior type southern yellow pine plywood for temporary protection, APA Grade C, plugged fir.

2.2 ACCESSORIES

A. Provide anchors, connectors, and fastenings, not indicated or specified otherwise, of the type, size and spacing necessary to suit the conditions encountered and as recommended by National Forest Products Association. Provide sizes, types, and spacing of nails, screws, or bolts for installation of manufactured building materials, as recommended by the product manufacturer, unless indicated or specified otherwise.

1. Zinc-electroplated steel rough hardware exposed to the weather unless indicated otherwise. Provide zinc-electroplated steel bolts, nuts, washers, hangers, and straps, and for all other rough hardware embedded in, or in contact with exterior walls or slabs, and located in humid areas, except as indicated otherwise.

2. Form and punch rough hardware before coating. Use common steel wire nails, bright finish, unless specified otherwise.

3. Provide bolt heads and nuts bearing on wood with standard steel washers.

4. Provide galvanized fasteners for treated wood in accordance with the requirements contained in Section 05 05 13.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install rough carpentry in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

B. Erection: Correctly lay out all carpentry throughout. Coordinate the Work of all built-in anchors and other devices. Carefully fit and erect, accurately locate, plumb, level, properly align, and rigidly secure in place all items of woodwork, hardware, and other work in connection with carpentry.

C. Protection of the Work: Protect the jambs of finished door frames and finished masonry openings to a height of 6 feet above the floor. Erect protection in a manner to facilitate cleaning, painting and similar work without damage to finished work.

D. Centers: Provide centers, where required, for brick and other masonry at the exterior and interior openings.

E. Blocking: Furnish blocking required for the attachment of copings, roof ventilators, ducts and other sheet metal work and wood grounds for other work and as shown and required.

F. Securing Finished Work: Provide all wood blocks, strips, plugs and similar items required to secure finished work to concrete and masonry.

G. Preservative Coating: Liberally coat all field-cut edges and surfaces of treated lumber with a concentrated solution of preservative.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 07 21 00 - THERMAL INSULATION PART

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Chemical Company; "Styrofoam Cavtymate Ultra SL".
 - a. Aged R-value: 5.6 minimum per inch thickness.
 - b. Total (minimum) Thickness: 3inches, single layer with ship-lapped vertical edges.
 - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 GLASS-FIBER BLANKET

- A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.3 SPRAYED POLYURETHANE FOAM INSULATION

- A. Closed-cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame spread and smoke developed indexes of 5 and 450, respectively, per ASTM E 84. Product shall contain no CFCs or urea formaldehyde. Product shall comply with

current state building code, including acceptable fire rating.

1. Manufacturers/Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); "Froth Pak".
 - b. Touch'n Seal/Foam Kit 200F
 - c. Manufacturer/Product that complies with current state building code for specific application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's

written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF SPRAY-APPLIED FOAM INSULATION

- A. Install spray-applied insulation according to manufacturer's written instructions. Place in miscellaneous voids and cavity spaces. Place spray-applied foam to provide airtight exterior building envelope.
- B. Install spray-applied foam insulation in interruptions and voids of rigid board insulation in exterior wall cavity to provide a monolithic insulation plane.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 27 26 - WEATHER BARRIERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes weather resistive barriers on exterior side of exterior wall sheathing.
- B. Flashing system installed with weather resistive barriers.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E-96-90 - Standard Test Method for Water Transmission of Materials.
 - 2. ASTM E-1677-95 - Standard Specification for an air Retarder (AR) material or System for Low-Rise Framed Building Walls.
- B. AATCC-127 Hydrostatic Head Test.

1.3 SUBMITTALS

- A. Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on material characteristics, performance criteria and limitations.
- C. Samples: Submit three samples of weather barrier, 12 x 12 inches.
- D. Manufacturer's Installation Instructions: Submit preparation, installation requirements and techniques, product storage and handling criteria.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain temperature and humidity recommended by materials manufacturers before, during and after installation.

1.5 SEQUENCING

- A. Sequence Work to permit installation of materials in conjunction with related materials and seals.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

- B. Coordinate the Work of this section with sections referencing this section.

PART 2 PRODUCTS

2.1 WEATHER RESISTANT BARRIER

- A. Spunbonded olefin, non-woven, non perforated.
- B. Performance Characteristics:
 - 1. ASTM E-1677, Type I Air Retarder. Air leakage at 25 mph (75 pa) wind pressure of less than 0.6 cfm/ft.
 - 2. Water vapor transmission of greater than 20 perms in accordance with ASTM E-96-90, Method B.
 - 3. Water penetration resistance of 200 cm on hydrostatic head in accordance with AATCC-127.
- C. Acceptable Manufacturers:
 - 1. Tyvek, Commercial Wrap by Dupont, Wilmington, DE, www.tyvek.com.
 - 2. Or approved equal

2.2 ACCESSORIES

- A. Tape: Dupont Contractor Tape as recommended by the Manufacturer.
- B. Fasteners For Wood Studs and Sheathing: Nails with large heads or plastic washers.
- C. Fasteners For Steel Framing: Rust-resistant screws with washers.
- D. Fasten to masonry with polyurethane or elastomeric adhesives.

2.3 WINDOW AND DOOR FLASHING SYSTEM

- A. All window and door penetrations shall be flashed according to the manufacturer's instructions.
- B. Flash all window and door penetrations with Dupont Flashing System utilizing Dupont StraightFlash and Dupont FlexWrap.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the manufacturer's instructions over exterior sheathing. Seal joints and penetrations through weather resistive barrier with specific tape and fasteners prior to installation of finish material. Weather resistive barrier shall be air

tight and free from holes, tears and punctures. All window and door penetrations are to be flashed and sealed per the manufacturer's instructions.

3.2 PROTECTION OF INSTALLED CONSTRUCTION

- A. Execution Requirements: Protecting installed construction.
- B. Do not permit adjacent work to damage work of this section.

END OF SECTION 07 27 26

(NO TEXT THIS PAGE)

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes flashings and counter-flashings, gutters and downspouts and fabricated sheet metal items.
- B. Aluminum wrap for exterior wood trim.

1.2 REFERENCES

- A. American Architectural Manufacturers Association:
 - 1. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. ASTM International:
 - 1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - Architectural Sheet Metal Manual.

1.3 DESIGN REQUIREMENTS

- A. Sheet Metal Flashings: Conform to the criteria of SMACNA "Architectural Sheet Metal Manual."
- B. Gutter and Downspout Components: Conform to SMACNA Manual for sizing components for rainfall intensity determined by storm occurrence of 1 in 10 years.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Product Data: Submit data on manufactured components metal types, finishes, and characteristics.
- D. Samples:
 - 1. Submit two samples 4 x 6 inch in size illustrating metal finish color.

1.5 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal work with minimum three years documented experience.

1.6 PRE-INSTALLATION MEETINGS

- A. Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials causing discoloration or staining.

1.8 COORDINATION

- A. Administrative Requirements: Coordination and project conditions.
- B. Coordinate with Work of other sections for installing recessed flashing reglets.

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

- A. Pre-Finished Aluminum Sheet: ASTM B209, manufacturer's standard alloy and temper for specified finish; 0.050 inch thick; finish shop pre-coated with manufacturer's standard 2 coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight complying with AAMA 2605. Standard color as selected by the Architect.

2.2 ALUMINUM WRAP FOR EXTERIOR WOOD TRIM

- A. Pre-Finished Aluminum Sheet: ASTM B209, manufacturer's standard alloy and temper for specified finish; 0.032 inch thick; finish shop pre-coated with manufacturer's standard 2 coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight complying with AAMA 2605. Standard color as selected by the Architect.

2.3 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Underlayment: ASTM D226, organic roofing felt, Type II, No. 30.
- C. Slip Sheet: Rosin sized building paper.
- D. Sealant: Polyurethane type, manufactured by Tremco or Sonneborn.
- E. Plastic Cement: ASTM D4586, Type I.
- F. Splash Pads: Precast concrete type, minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

2.4 FABRICATION

- A. Form sections shape indicated on Drawings, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet metal, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- H. Fabricate snow guards in accordance with SMACNA Plate 159.
- I. Fabricate gutters to profile and size indicated.
- J. Fabricate downspouts to profile and size indicated.
- K. Fabricate accessories in profile and size to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA requirements.
- L. Seal metal joints.

2.5 FACTORY FINISHING

- A. PVDF (polyvinylidene fluoride) coating: Multiple coat, thermally cured, fluoropolymer system conforming to AAMA 2605.
- B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Administrative Requirements: Coordination and project conditions.
- B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets to lines and levels indicated on Drawings. Seal top of reglets with sealant.
- C. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mil (0.4 mm).

3.3 INSTALLATION

- A. Secure flashings in place using concealed fasteners.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.
- E. Install snow guards up slope from eaves.
- F. Secure gutters and downspouts in place using fasteners.
- G. Slope gutters minimum 1/8 inch per foot.

- H. Connect downspouts to downspout boots or drainage system as indicated on the drawings. Seal connection watertight.
- I. Set splash pads under downspouts.
- J. Seal metal joints watertight.

END OF SECTION 07 62 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Latex joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Silicone, Non-staining, S, NS, 50, NT: Non-staining, single-component, non-sag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 795.
 - b. GE Construction Sealants; Momentive Performance Materials Inc; SilPruf NB.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 295 FPS NB.
 - d. Pecora Corporation; 895NST.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, non-sag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Sonalastic TX1.
 - b. Pecora Corporation; Dynatrol I-XL.
 - c. Sika Corporation U.S.; Sikaflex Textured Sealant.
 - d. Tremco Incorporated; Dymonic.

2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Sonolac.
 - b. Pecora Corporation; AC-20.
 - c. Tremco Incorporated; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type O (open-cell material), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
- 3.4 CLEANING
- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- 3.5 PROTECTION
- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00 JOINT SEALANTS

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
4. Division 08 Section "Door Hardware".
5. Division 08 Section "Access Control Hardware".
6. Division 08 Section "Sanitary and Water Tight Doors and Frames"
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.

2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".

- a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
- b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.
- c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.

4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).

5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.

6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".

7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors – Reference Section 083919

D. Manufacturers Basis of Design:

- 1. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.
- 2. Curries Company (CU) – 780 Series – Interior Doors.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Weatherstripped Frames: Subject to the same compliance standards and requirements as standard hollow metal frames, provide where indicated weatherstripped profiles with 1/8" integral kerf formed into the frame soffit able to receive manufacturer's listed gasket material. Available for use in both masonry and drywall construction, with fire rating up to 3 hours complying with NFPA 105, UL 1784, and ASTM E-283 Test criteria.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

- 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
- 2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
- 3. Manufacturers Basis of Design:

- a. Curries Company (CU) – Kerfed Weatherstripped WM Series.

D. Interior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Reference Section 083919

2. Manufacturers Basis of Design:

- a. Curries Company (CU) - C Series.
- b. Curries Company (CU) - M Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

- 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
5. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware". Wire nut connections are not acceptable.

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- 1) Two anchors per jamb up to 60 inches high.
- 2) Three anchors per jamb from 60 to 90 inches high.
- 3) Four anchors per jamb from 90 to 120 inches high.
- 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- 1) Three anchors per jamb up to 60 inches high.
- 2) Four anchors per jamb from 60 to 90 inches high.
- 3) Five anchors per jamb from 90 to 96 inches high.
- 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

- a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
- b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
- d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081113

SECTION 08 33 23 - OVERHEAD COILING DOORS PART

1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, and other accessories.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 3. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.2 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACME Rolling Doors.
 - b. C.H.I. Overhead Doors, Inc.
 - c. Cornell Iron Works, Inc.
 - d. Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Curtain R-Value: 6.0 deg. F x h x sq. ft./Btu.

- D. Door Curtain Material: Aluminum.
- E. Door Curtain Slats: Flat
 - 1. Vision Panels: Approximately 10- by 1-5/8-inch openings spaced approximately 2 inches apart and beginning 12 inches from end guides; in three rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
 - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8-inch-thick; fabricated from aluminum extrusions and finished to match door.
- G. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- I. Locking Devices: Equip door with chain lock keeper.
- J. Manual Door Operator: Chain-hoist operator.
- K. Curtain Accessories: Equip door with weather seals.
- L. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Aluminum Door Curtain Slats: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
 - 2. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
 - 3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.

- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding wind locks.

2.4 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Stainless Steel: 0.025-inch- thick, stainless-steel sheet, Type 304, complying with ASTM A 666.
 - 2. Aluminum: 0.040-inch- thick aluminum sheet complying with ASTM B 209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

2.5 LOCKING DEVICES

- A. Chain Lock Keeper: Suitable for padlock.

2.6 CURTAIN ACCESSORIES

- A. Weather seals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.7 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.8 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

END OF SECTION 08 33 23

SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum windows for exterior locations.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: AW.
 - 2. Minimum Performance Grade: 40.
- C. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

2.2 ALUMINUM WINDOWS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arcadia, Inc..
 - 2. Kawneer North America; an Alcoa company.
 - 3. Manko Window Systems, Inc..
 - 4. Wausau Window and Wall Systems; Apogee Wausau Group.
 - 5. YKK AP America Inc.
- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntin's with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- C. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.
 - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

2.3 ACCESSORIES

- A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated

on Drawings.

- B. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.4 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.5 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic or polyester enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of 1.5 mils, medium gloss.
 - 2. Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 51 13

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - a. Swinging doors.
 - b. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - a. Mechanical door hardware.
 - b. Electromechanical door hardware.
 - c. Cylinders specified for doors in other sections.
- C. Related Sections:
 - a. Division 08 Section "Hollow Metal Doors and Frames".
 - b. Division 08 Section "Sanitary and Watertight Doors and Frames".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - a. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - b. ICC/IBC - International Building Code.
 - c. NFPA 70 - National Electrical Code.
 - d. NFPA 80 - Fire Doors and Windows.
 - e. NFPA 101 - Life Safety Code.
 - f. NFPA 105 - Installation of Smoke Door Assemblies.
 - g. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - a. ANSI/BHMA Certified Product Standards - A156 Series.
 - b. UL10C - Positive Pressure Fire Tests of Door Assemblies.

2. ANSI/UL 294 - Access Control System Units.
3. UL 305 - Panic Hardware.
4. ANSI/UL 437 – Key Locks

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
 - C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

- a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
 - D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
 - E. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
 - F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
 - F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
 - G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
 - H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
 - I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
 - B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - e. One additional hinge on doors 3'8" wide to 4'0" wide up to 90-inches high when the door is using a door closer.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

- 1) Interior door that is 3'8" to 4'0" wide, require heavy weight hinges.

4. Hinge Options: Comply with the following:

- a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

- a. McKinney (MK) - TA/T4A Series, 5 knuckle.

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. Securitron (SU) - EL-CEPT Series.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

- a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
- b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

- a. McKinney (MK) - QC-C Series.

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 - 4. Tubular deadlocks and other auxiliary locks.
 - 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 6. Keyway: Match Facility Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. Existing System: Field verify and key cylinders to match Owner's existing system.
- D. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
 - 4. Construction Control Keys (where required): Two (2).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Construction Keying: Provide temporary keyed construction cores.
- G. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
- 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Heavy duty mortise locks shall have a ten-year warranty.
2. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180-degree viewing angle with protective covering to prevent tampering.
3. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.
 - 1) Lever design to match facility standards

2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.

2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
 - B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.

2.9 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 25-year warranty.

2. Manufacturers:

- a. Corbin Russwin Hardware (RU) - DC6000 Series.
- b. Norton Rixson (NO) - 7500 Series.
- c. Sargent Manufacturing (SA) - 351 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Manufacturers:

- a. Corbin Russwin (RU) - DC5000 Series.
- b. Norton Rixson (NO) - 2800ST Series.
- c. Sargent Manufacturing (SA) - 422 Series.

2.10 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.11 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
 - B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
1. Manufacturers:
 - a. Rockwood (RO).

- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

- 1. Manufacturers:

- a. Norton Rixson (RF).

2.12 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

- 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

- 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
 - E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

- F. Manufacturers:

- 1. Pemko (PE).

2.13 ELECTRONIC ACCESSORIES

- A. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall

provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.

1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
2. Manufacturers:
 - a. Securitron (SU) - AQL Series.

2.14 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
 - B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
 - C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - D. Door Closers:
 - 1. Install closers on room side of corridor doors, and stair side of stairways.
 - 2. Lobby doors: Mount on vestibule side.
 - 3. Exterior doors: Parallel rigid arm installation.
 - 4. Where through-bolts are required, install closers using only manufacturer-furnished through-bolts.
 - 5. Install closers using only manufacturer-furnished template machine screws for metal doors and manufacturer -furnished wood screws for wood doors.
 - 6. Coordinate with door supplier to provide proper blocking for surface mounting.
 - 7. Use of self-drilling or self-tapping fasteners is not allowed.
 - 8. Where full glazed door units are specified, use closer arm and mounting configuration as required to avoid use of drop brackets whenever possible.
 - E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
 - F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

END OF SECTION 08 71 00

(NO TEXT ON THIS PAGE)

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Glass for windows and doors.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches square.
 - 1. Tempered glass.

- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
 1. Guardian Industries Corp.; SunGuard.
 2. Oldcastle Building Envelope.
 3. PPG Industries, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 1. Obtain tinted glass from single source from single manufacturer.
 2. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- C. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving

sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to

fit openings exactly, with allowance for stretch during installation.

- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without

damage to coatings.

- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type TG: Clear fully tempered float glass.

- 1. Minimum Thickness: 6 mm.

3.9 INSULATING GLASS SCHEDULE

- A. Glass Type IG-1: Low-E-coated, clear insulating glass.

- 1. Basis-of-Design Product: SunGuard SuperNeutral 54.
 - 2. Overall Unit Thickness: 1 inch.
 - 3. Minimum Thickness of Each Glass Lite: 6 mm.
 - 4. Outdoor Lite: Fully tempered float glass.
 - 5. Interspace Content: Air.
 - 6. Indoor Lite: Fully tempered float glass.
 - 7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
 - 8. U-Factor: .29 maximum.
 - 9. Shading Coefficient: .32
 - 10. Visible Light Transmittance: 54 percent minimum.
 - 11. Solar Heat Gain Coefficient: .28 maximum.
 - 12. Safety glazing required.

END OF SECTION

(NO TEXT THIS PAGE)

SECTION 09 90 00 - PAINTS AND COATINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints and coatings as indicated.
- B. Work includes all painting and finishing of interior and exterior exposed items and surfaces, throughout project, except as otherwise indicated.
 - 1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified as work of other sections.
- C. Work includes field painting of exposed bare and covered pipes and ducts, and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.
- D. Work includes painting all process piping with color-coded colors. Green for raw, beige for backwash, and blue for finished water.
- E. "Paint" as used herein means all coating systems materials including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as primer, intermediate or finish coats.
- F. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, the Architect will select these from manufacturer's standard range of colors or finishes.
- G. Sheen to specific applications is as follows:
 - 1. Flat (0-10)
 - 2. Eggshell (10-20)
 - 3. Satin (20-40)
 - 4. Semi-Gloss (45-65)
 - 5. Gloss (75+)

1.2 RELATED WORK NOT INCLUDED

- A. Pre-finished Items: Unless otherwise indicated, do not include painting when factory finishing or Installer-finishing is specified for such items as (but not limited to) metal toilet partitions, pre-finished partition systems, acoustic materials, pre-finished casework, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.

- B. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
- C. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
- D. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts will not require finish painting.
- E. Shop Priming: Unless otherwise indicated, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
- F. Do not paint over any code required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
 - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
- B. Painting and Decorating Contractors of America:
 - 1. PDCA - Architectural Painting Specification Manual.
- C. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.

1.4 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.5 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on all finishing products.
- C. Samples:
 - 1. Submit two paper chip samples, illustrating range of colors and textures available for each surface finishing product scheduled.

2. Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on, 8-1/2 x 11 **inch** in size.

- D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, substrate conditions requiring special attention, and conditions.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 MOCKUP

- A. Section 01400 - Quality Requirements: Mock-up requirements.
- B. Construct mockup panel, 8 feet tall by 8 feet wide, illustrating coating color, texture, and finish.
- C. Locate where directed.
- D. Incorporate accepted mockup as part of Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. 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.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.

- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish and Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candle (860 lx) measured mid-height at substrate surface.

1.11 EXTRA MATERIALS

- A. Section 01 73 00 - Execution: Spare parts and maintenance products.
- B. Supply 2 gallons (8 L) of each color, type, and surface texture; store where directed.
- C. Label each container with color, type, texture, room locations, and in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Manufacturers:
 - 1. Benjamin Moore & Co.
 - 2. Devoe Paint Co.
 - 3. Duron Inc.
 - 4. The Glidden Co.
 - 5. ICI Paints.
 - 6. MAB Paints.
 - 7. Porter Paints.
 - 8. PPG Architectural Finishes, Inc.
 - 9. Sherwin-Williams.

2.2 COMPONENTS

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

- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 10 00 - Summary: Coordination and project conditions.
- B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors: 8 percent.

3.2 PREPARATION

- A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- I. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- J. Copper Surfaces Scheduled for Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.
- K. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- L. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- M. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- N. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- O. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by power tool wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- P. Shop Primed Steel Surfaces: 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.
- Q. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

- R. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- S. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.
- T. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.
- U. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- V. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with tinted primer.
- W. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. Sand wood and metal surfaces lightly between coats to achieve required finish.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- F. Prime concealed surfaces of interior and exterior woodwork with primer paint.
- G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.
- H. Finishing Mechanical and Electrical Equipment:
 - 1. Refer to Mechanical and Electrical Sections for schedule of color coding and identification banding of equipment, duct work, piping and conduit.
 - 2. Paint shop primed equipment.

3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and except where items are shop finished.
5. Paint interior surfaces of air ducts and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
6. Paint exposed conduit and electrical equipment occurring in finished areas.
7. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
8. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated.
9. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
10. Paint tanks, heat exchangers, ductwork and insulation, motors and accessories.

3.4 CLEANING

- A. Section 01700 - Execution Requirements: Final cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.5 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Metal Fabrications : Exposed surfaces of lintels, access ladders, and handrails.
- B. Metal Stairs : Exposed surfaces of stringers, exposed vertical risers, bottom of exposed treads and risers.

3.6 SCHEDULE - EXTERIOR SURFACES

- A. All paints and related products are to be the best in quality for each application designated. If technology and products have been developed or upgraded, the Architect shall be notified and advised as to the best product from each manufacturer for the application specified All substitutions shall be submitted as per Specification Section 01 60 00.
- B. Wood - Painted (Opaque):
 1. One coat of latex or alkyd primer sealer.
 - a. Sherwin Williams Exterior Latex Wood Primer B42 Series
 2. Two coats of alkyd or latex enamel, gloss.
 - a. Sherwin Williams A-100 Exterior Latex Gloss A8 Series
- C. Wood - Transparent:
 1. Two coats of stain.

- a. Sherwin Williams Woodscapes Exterior Semi-Transparent Polyurethane Stain A15T5
- D. Wood - Shingles and Shakes:
 - 1. Two coats of stain.
 - a. Sherwin Williams Woodscapes Exterior Semi-Transparent Polyurethane Stain A15T5
- E. Glue-Laminated Wood and Wood Timber Members:
 - 1. Two coats of stain.
 - a. Sherwin Williams Woodscapes Exterior Semi-Transparent Polyurethane Stain A15T5
- F. Concrete, Cement Plaster & Masonry other than concrete masonry units:
 - 1. One coat of block primer.
 - a. Sherwin Williams Loxon Masonry Primer A24 Series
 - 2. Two coats of latex or alkyd, flat.
 - a. Sherwin Williams A-100 Exterior Flat A6 Series
- G. Concrete Masonry Units:
 - 1. Filler coat:
 - a. Sherwin Williams Heavy Duty Blockfiller B42W46
 - 2. Two coats of latex or alkyd, flat.
 - a. Sherwin Williams A-100 Exterior Latex Flat A6 Series
- H. Concrete Masonry Units with Heavy Duty Textured Coating:
 - 1. Two coats heavy duty textured coating with a total dry film thickness of 9.4-11mils DFT.
 - a. Sherwin Williams ConFlex XL High Build Textured Coating A5-800 Series)
- I. Steel - Unprimed:
 - 1. One coat of latex or alkyd primer.
 - a. Sherwin Williams Pro Industrial Pro -Cryl Acrylic Primer B66 Series
 - 2. Two coats of alkyd or latex enamel, gloss.
 - a. Sherwin Williams Sher-Cryl High Performance Acrylic Coating B66 Series
- J. Steel - Shop Primed:
 - 1. Touch-up with Anti-Corrosive Primer.
 - a. Sherwin Williams Pro Industrial Pro-Cryl Acrylic Primer B66 Series
 - 2. Two coats of alkyd or latex enamel, gloss.
 - a. Sherwin Williams Sher-Cryl High Performance Acrylic Coating B66 Series
- K. Steel - Galvanized:
 - 1. One coat galvanize primer.
 - a. Sherwin Williams Pro Industrial Pro-Cryl Primer B66 Series
 - Two coats of alkyd or latex enamel, gloss.
 - a. Sherwin Williams Sher-Cryl High Performance Acrylic Coating B66 Series

- L. Aluminum - Mill Finish:
 - 1. One coat primer.
 - a. Sherwin Williams Pro Industrial Pro-Cryl Primer B66 Series
 - 2. Two coats of alkyd enamel, gloss.
 - a. Sherwin Williams Sher-Cryl High Performance Acrylic Coating B66 Series

3.7 SCHEDULE - INTERIOR SURFACES

- A. Wood - Painted:
 - 1. One coat of latex or alkyd prime sealer.
 - a. Sherwin Williams Premium Wall and Wood Primer B28 Series
 - 2. Two coats of alkyd or latex enamel, semi-gloss.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series
- B. Wood - Transparent:
 - 1. Filler coat (for open grained wood only).
 - a. MAB – None required
 - 2. Two coats of stain.
 - a. Sherwin-Williams Wood Classics 250 Interior Wood Stain A49 Series.
 - 3. One coat sealer.
 - a. Sherwin Williams Wood Classics Waterborne Polyurethane A68 Series
 - 4. Two coats of varnish, gloss or satin.
 - a. Sherwin Williams Wood Classics Waterborne Polyurethane A68 Series
- C. Glue-Laminated Wood or Wood Timber Members:
 - 1. One coat of stain.
 - a. Sherwin Williams Wood Classics 250 Interior Wood Stain A49 Series
 - b. Sherwin Williams Wood Classics Waterborne Polyurethane A68 Series
- D. Concrete, Cement Plaster or Masonry other than Concrete Masonry Units:
 - 1. One coat of primer sealer latex or alkyd.
 - a. Sherwin-Williams Loxon Concrete and Masonry Primer B28 Series
 - 2. Two coats of latex or alkyd satin.
 - a. Sherwin-Williams ProMar 200 Zero VOC Interior Latex Low Sheen B24-2600 Series
- E. Concrete Masonry Units:
 - 1. Filler coat:
 - a. Sherwin Williams Interior/Exterior Blockfiller B25W25
 - 2. Two coats of latex or alkyd, satin.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Eg-Shel B20-2600 Series
- F. Steel - Unprimed:
 - 1. One coat of alkyd or latex primer.
 - a. Sherwin Williams ProIndustrial Pro Cryl Primer B66 Series

2. Two coats of alkyd or latex enamel, semi-gloss.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series
- G. Steel - Primed:
 1. Touch-up with alkyd or latex primer.
 - a. Sherwin Williams Pro Industrial Pro Cryl Primer B66 Series
 2. Two coats of alkyd or latex enamel, semi-gloss.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series
- H. Steel - Galvanized:
 1. One coat galvanize primer.
 - a. Sherwin Williams Pro Industrial Pro Cryl Primer B66 Series
 2. Two coats of alkyd or latex enamel, semi-gloss.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series
- I. Aluminum - Mill Finish:
 1. One coat primer:
 - a. Sherwin Williams Pro Industrial Pro Cryl Primer B66 Series
 2. Two coats of latex enamel, gloss.
 - a. Sherwin Williams DTM Acrylic Gloss Coating B66 Series
- J. Concrete Floors:
 1. One coat of alkali resistant catalyzed epoxy primer.
 - a. Sherwin Williams armor Seal Floor Plex 7100 B70W410
 2. One coat of catalyzed epoxy enamel, semi-gloss
 - a. Sherwin Williams Armor Seal Floor Plex 7100 B70W400
- K. Gypsum Board and Plaster Walls and Ceilings:
 1. One coat of latex primer sealer.
 - a. Sherwin Williams Pro Green 200 Latex Primer B28W600
 2. Two coats of alkyd or latex enamel, satin.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Eg-Shel B20-2600 Series
- L. Insulated Coverings - Canvas and Cotton:
 1. One coat of latex primer sealer with fungicidal agent added to render fabric mildew-proof.
 - a. Sherwin Williams ProGreen 200 Latex Primer B28W600
 2. Two coats of latex, flat.
 - a. Sherwin Williams ProMar 200 Zero VOC Interior Latex Flat B30-2600 Series

END OF SECTION 09 90 00

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SECTION 09 96 00 – HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Preparation of surfaces, shop painting of items furnished, field painting of new structures, and masonry waterproofing.

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. SSPC - The Society for Protective Coatings
 - a. SSPC SP 1 - Solvent Cleaning
 - b. SSPC SP 2 - Hand Tool Cleaning
 - c. SSPC SP 3 - Power Tool Cleaning
 - d. SSPC SP 5 - White Metal Blast Cleaning
 - e. SSPC SP 6 - Commercial Blast Cleaning
 - f. SSPC SP 10 - Near-White Blast Cleaning
 - g. SSPC SP 11 - Power Tool Cleaning to Bare Metal
 - h. SSPC SP 13 - Surface Preparation of Concrete
 - i. SSPC SP 16 - Brush-off Blast Cleaning of Non-Ferrous Metals
 - 2. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
 - 3. NACE SP0178 - Standard Practice for Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service

1.3 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
 - 1. Submit manufacturer's standard color chart for color selection.

2. Furnish affidavits from the manufacturer certifying that materials furnished conform to the requirements specified and that paint products have been checked for compatibility.
3. Submit a supplementary schedule of paint products with mil thickness and solids by volume, including all paint applied in the shop and in the field. Provide a schedule that is in accordance with the recommendations of the paint manufacturer.
4. Furnish affidavits from the manufacturer certifying that coatings in immersion service contain no water soluble solvents or corrosion inhibitive (active) pigments with slight water solubility.

1.4 PAINTING REQUIREMENTS

- A. Shop Primed and Field Painted Items: Furnish the following items shop primed and field painted: structural steel and wrought metals, hangers and supports, steel stair framing, and steel lintels.
- B. Unpainted Items: Do not paint the following items, unless otherwise specified: floor gratings, stainless steel, surfaces to receive field welding, faying surfaces of high strength bolted connections, and steel to be embedded or in contact with cast-in-place concrete.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)
- B. Delivery and Storage: Deliver and store paint at the site from the approved manufacturer only.
- C. Packaging and Labeling: Prepare, pack and label paints, stains, varnish or ingredients of paints to be used on the job. Deliver all material to the site in original, unbroken containers.
- D. Storage: Store the painting materials at the site in accordance with applicable codes and regulations and in accordance with manufacturer's instructions. Keep the storage space clean at all times. Take every precaution to eliminate fire hazards.

1.6 JOB CONDITIONS

- A. Provide all necessary labor equipment supplies, power and materials to protect the surrounding property and facilities and personnel during sandblasting and

painting operations and preclude the migration of sandblast residue or coating materials.

1.7 QUALITY ASSURANCE

- A. Observe all applicable local, state and federal rules and regulations for removal, storage and disposal of sandblast residue, and for application of the new coating systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Paint - General:

- a. AkzoNobel (Ceilcote, Devoe, Enviroline, International)

2. Protective Coating – Concrete and concrete-block parapet walls, concrete roofs of walkways and where indicated

- a. Mameco; Vulkum 450/451 over 171 primer

2.2 MATERIALS

- A. General: Furnish paint and other materials of the type and quality of the manufacturer on which the painting schedule specified herein is based.

1. Provide compatible shop and field coats.
2. Provide all coats of paint for any particular surface from the same manufacturer.
3. Provide paint of approved color as selected from the manufacturer's standard range of colors.

- B. Paint Schedule: Provide all painting in accordance with the following schedule with the number of coats not less than the number shown on the schedule.

| Class of Work | Surface | Field Coats | | | Total |
|-------------------|-------------|-------------|-----|-----|----------|
| | Preparation | 1st | 2nd | 3rd | DFT |
| Steel-Structural: | | | | | |
| Exterior | SSPC-SP 6 | E | F | C | 8.5-15.0 |

| Class of Work | Surface | Field Coats | | | Total |
|------------------------------------|-------------|-------------|-----|-----|-----------|
| | Preparation | 1st | 2nd | 3rd | DFT |
| Concrete Walls (Cast and Precast): | | | | | |
| Below Grade | SSPC SP-13 | H | | | 16.0-20.0 |
| Exterior Exposed | SSPC SP-13 | O | N | N | 7.0-10.0 |

- C. Schedule of Paints: Alphabetical designations in the following list are given solely for the purpose of indicating the type and quality of materials desired. Equivalent material from other approved manufacturers may be submitted for approval.

| <u>Symbol</u> | <u>Product Name and Number</u> | <u>Volume Solids %</u> | <u>Dry Film Thickness Mils Per Coat</u> | <u>VOCs (g/L)</u> |
|---------------|---|----------------------------|---|-----------------------|
| A | International Paint-Devoe Coatings Bar-Rust 231 | 71 | 4.0-8.0 | 271 |
| B | International Paint-Devoe Coatings Bar-Rust 233H | 80 | 4.0-6.0 | 170 |
| C | International Paint-Devoe Coatings Devthane 379 | 63 | 2.0-3.0 | 311 |
| D | International Paint-Devoe Coatings Pre-Prime 167 | 100 | 1.0-1.5 | 95 |
| E | International Paint-Devoe Coatings Cathacoat 302H | 78 | 2.5-4.0 | 282 |
| F | International Paint-Devoe Coatings Devran 224V | 77 | 4.0-8.0 | 28 |
| G | International Paint-Devoe Coatings Devran 201H | 58 | 2.0-3.0 | 327 |
| H | International Paint-Devoe Coatings Devtar 5A-HS | 79 | 16.0-20.0 | 98 |
| I | International Paint-Devoe Coatings Intertherm 228HS | 70 | 4.0-6.0 | 265 |
| J | International Paint-Devoe Coatings Tru-Glaze 4015 | 53 | 9.0-11.0 | 99 |
| L | International Paint-Devoe Coatings Tru-Glaze 4015 | 53 | 9.0-11.0 | 99 |
| M | International Paint-Devoe Coatings Tru-Glaze-WB 4428 | 36 | 2.0-4.0 | 43 |
| N | International Paint-Devoe Coatings Devcryl 1448 – Semi-gloss | 38 | 1.5-4.0 | 98 |
| O | International Paint-Devoe Coatings Devran 203 | 45 | 3.0-4.0 | 91 |
| P | International Paint-Devoe Coatings Devcryl 1440 | 44 | 2.0-3.0 | 77 |

PART 3 EXECUTION

3.1 REPAIR

- A. Fill all pits in concrete having a depth in excess of 1/8 of an inch with a 100 percent solids epoxy repair compound.
- B. Notify the ENGINEER of all pits with a depth greater than 1/4 inch to determine whether structural repairs are necessary. Repair such pits in a manner approved by ENGINEER.

3.2 PREPARATION

- A. Inspection: Prior to surface preparation perform the following:
 - 1. Verify that surface substrate conditions are ready to receive Work as instructed by the product manufacturer.
 - 2. Examine specifications for all Work and become thoroughly familiar with all provisions regarding painting.
 - 3. Document conditions of substrate prior to beginning work. Indicate any damaged or deficient substrates requiring repair and report findings to the ENGINEER.
- B. Surface Preparation: After inspection and prior to painting, perform the following:
 - 1. Inspect all Work prior to application of any paint or finishing material.
 - 2. Brush and wash concrete and masonry surfaces. Remove all loose dirt, free lime, form oil, curing compounds and other foreign matter by approved methods such as SSPC SP13. Patch concrete surfaces requiring repair and spackle and repair surfaces to receive paint. Acid etch concrete surfaces to be painted as recommended by the manufacturer of the coating to be applied, to produce a slightly granular surface required for adherence of the paint to the concrete unless otherwise indicated. Determine that concrete and concrete masonry is thoroughly dry prior to painting per ASTM D4263.
 - 3. Thoroughly clean surfaces to be given protective coatings.
 - 4. Do not begin field painting prior to approval of the surface preparation.
 - 5. Prepare and clean all surfaces prior to painting, as specified and required. Verify that surfaces are dry before any paint is applied. Perform special surface preparation work as directed by the manufacturer of the paint specified to be applied to the surface.
 - 6. Clean the surface of structural steel by removing all rust, mill scale, oil, grease or dirt in accordance with SSPC-SP6.

7. Prior to painting steel, grind smooth all welds, beads, blisters or protuberances per NACE SP0178, other than identification markings and remove other imperfections. Remove all rust, mill scale, oil, grease and dirt by abrasive blasting in accordance with SSPC-SP-10 unless otherwise indicated.
8. Prime cleaned metal the same day immediately after sandblasting to prevent rusting.

3.3 INSTALLATION

- A. General: Install all painting and coatings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
 1. Refer to manufacturer's guidelines as it relates to minimum/maximum allowable temperatures for application.
 2. The surface temperature of the steel shall be at least 5 degrees F above the dew point.
 3. Paint surfaces in accordance with the material painting schedule included in this Section.
 4. Completely cover all surfaces to be painted. Cover by additional coats when color on undercoats shows through the final coat of paint, until paint is of uniform color and appearance and coverage is complete.
 5. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
 6. Provide sufficient temporary ventilation during painting operations in enclosed areas to remove moisture and solvents, and to keep the atmosphere safe from harmful or dangerous fumes and dust levels for personnel.
- B. Touch-Up Shop-Primed and Finished Items: Touch-up all damaged portions and imperfections in shop-primed and finished items. Use the same paint as used for the shop prime and finish. Prepare the surface prior to touch-up by wire brushing and sanding to remove rust, scale and loose paint per SSPC SP 2, 3, or 11, as determined by each situation.
- C. Aluminum and Incompatible Surfaces: Where aluminum surfaces come in contact with incompatible metals, lime, mortar, concrete or other masonry materials, apply one field coat of International Paint-Devco Coatings Bar-Rust 231 Epoxy or two coats of asphalt varnish conforming to FS-TT-V-51F. The aluminum surface

should be abraded to a 1.5-2.0 mil profile before coatings application is done to ensure maximum adhesion to the surface.

D. Field Painting: Perform field painting at the job site as follows:

1. Mix all paints and similar materials in approved containers of adequate capacity.
2. Mix all paint thoroughly before being taken from the containers. Keep mixed while painting. Apply all ready-mixed paint exactly as received from the manufacturer without addition of any kind of drier or thinner, except as specified, to mix colors to conform to approved color schedule. Tint successive coats of paint to make various coats easily distinguishable. Tint undercoats of paint to the approximate shade of the final coat of paint.
3. Use only skilled painters on the Work, and employ specialists where required. Apply paint by brush, roller or sprayer in accordance with the manufacturer's recommendation.
4. Thoroughly and uniformly sand undercoats on hollow metal Work with No. 00 sandpaper or equal abrasive to remove all surface defects and provide a smooth, even surface. Do not allow brush marks or other irregularities on finished surfaces.
5. Perform painting as a continuous and orderly operation to facilitate adequate inspection. Prime coat and paint materials subject to weathering or corrosion before erection. Perform all paint application methods in accordance with the instructions of the paint manufacturer and as approved.
6. Fully protect areas under and adjacent to painted work at all times and promptly remove dripped or spattered paint.
7. Repair, refinish and repaint any adjacent surfaces that have been damaged or discolored by overspray.
8. Do not paint when the air or surface temperature is below that recommended by the manufacturer, or in dust-laden air, or until moisture on the surface has completely disappeared. If necessary, provide sufficient heating and ventilation to keep the atmosphere and all surfaces to be painted dry and warm until each coat of paint has hardened.
9. Remove any painting found defective. Touch-up and provide remedial painting as directed and as required until completion and acceptance of final work.

10. Apply coatings at vertical and horizontal surfaces in strict conformance with the coating manufacturer's recommendations.

3.4 HEALTH AND SAFETY

A. Introduction

1. Products listed in this specification and used in high-performance coatings situations contain high volume solids; the aerosol droplets/particulates produced during airless spray of some of these materials may form an explosive mixture with air and additionally may contain materials which may necessitate personal protection against potential health hazards. A summary of the main precautions to be taken includes:

- Danger of explosion or fire
- Provision of a suitable breathing environment for workers.
- Prevention of skin irritation problems.
- Use of paints which have been specially formulated for use in tanks.

- B. Consult with manufacturer prior to commencing work to review recommended Health and Safety procedures.

3.5 QUALITY CONTROL

A. General Coatings:

1. At least daily, check temperature, humidity, and Dew Point as to time and readings obtained. Submit "Paint Inspection: Daily Coating Inspection Report" to ENGINEER on a daily basis. See Supplement below.
2. Perform daily wet film thickness readings or spreading rate checks to make certain that proper film thickness is being achieved. If proper film thickness is not being achieved more frequent checks may be required by the ENGINEER at their discretion. Provide daily written report to ENGINEER. Correct any deficiencies in film thickness by application of additional paint. See Supplement below.

3.6 CLEANING AND FINAL TOUCH UP PAINTING

- A. Touch up and restore any damaged finish. Remove paint or other finishes spilled, splashed or splattered from all surfaces taking care not to mar any surface or item being cleaned.

3.7 SUPPLEMENT

- A. The supplement listed below is a part of this Specification:

1. Paint Inspection: Daily Coating Inspection Report

Paint Inspection:
Daily Coating Inspection Report

| Project/Client: | | | | | | Date: / / M T W Th F S Su | | Pg. Of | | | | | | | | | | | | | | | |
|---|---------------|----------------------|---------------|---------------|---------------|---|---------------|---|---------------|---------------|---------------|---------------|--|--|--|--|--|--|--|--|--|--|--|
| Location: | | | | | | Project #: | | COPY To: | | | | | | | | | | | | | | | |
| Description: | | | | | | Inspector: | | <input type="checkbox"/> QC Mgr <input type="checkbox"/> Owner <input type="checkbox"/> Contr <input type="checkbox"/> _____ | | | | | | | | | | | | | | | |
| Requirements: | | | | | | | | Attachments: | | | | | | | | | | | | | | | |
| Contractor: | | | | | | Spec # | | <input type="checkbox"/> DFT Sheet <input type="checkbox"/> NCR/CAR <input type="checkbox"/> _____ | | | | | | | | | | | | | | | |
| Revision # | | | | | | | | | | | | | | | | | | | | | | | |
| Description of Areas & Work Performed | | | | | | Hold Point Inspections Performed | | | | | | | | | | | | | | | | | |
| | | | | | | <input type="checkbox"/> 1 Pre Surface Prep/Condition & Cleanliness <input type="checkbox"/> 2 Surface Preparation Monitoring <input type="checkbox"/> 3 Post Surface Preparation/Cleanliness & Profile <input type="checkbox"/> 4 Pre Application Prep/Surface Cleanliness <input type="checkbox"/> 5 Application Monitoring/Wet Film Thickness (WFT) <input type="checkbox"/> 6 Post Application/Application Defects <input type="checkbox"/> 7 Post Cure/Dry Film Thickness (DFT) <input type="checkbox"/> 8 Nonconformance/Corrective Actions Follow-up <input type="checkbox"/> 9 Final Inspection | | | | | | | | | | | | | | | | | |
| | | | | | | Approved By: _____ | | | | | | | | | | | | | | | | | |
| Surface Conditions | | | | | | Ambient Conditions | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> New <input type="checkbox"/> Maint <input type="checkbox"/> Primer/Paint <input type="checkbox"/> Age/Dry/Cure _____ <input type="checkbox"/> Steel <input type="checkbox"/> Galvanize <input type="checkbox"/> Concrete <input type="checkbox"/> Other _____ <input type="checkbox"/> Hazard _____ <input type="checkbox"/> Sample Report # _____ <input type="checkbox"/> Degree of contamination: _____ Test: <input type="checkbox"/> Cl _____ $\mu\text{g}/\text{cm}^2$ / ppm <input type="checkbox"/> Fe _____ ppm <input type="checkbox"/> pH _____ <input type="checkbox"/> Degree of Corrosion: _____ <input type="checkbox"/> Scale <input type="checkbox"/> Pitting/Holes <input type="checkbox"/> Crevices <input type="checkbox"/> Sharp Edges <input type="checkbox"/> Weld _____ <input type="checkbox"/> Moisture <input type="checkbox"/> Oils <input type="checkbox"/> Other _____ <input type="checkbox"/> Painted Surface Condition: _____ Dry to: <input type="checkbox"/> Touch <input type="checkbox"/> Handle <input type="checkbox"/> Recoat <input type="checkbox"/> Dry/Over Spray <input type="checkbox"/> Runs/Sags <input type="checkbox"/> Pinholes <input type="checkbox"/> Holidays <input type="checkbox"/> Abrasion <input type="checkbox"/> Fall Out <input type="checkbox"/> Other _____ | | | | | | Time (Indicate AM or PM) : : : : Dry Bulb Temp ⁰ (C/F) : : : : Wet Bulb Temp ⁰ (C/F) : : : : % Relative Humidity % % % % Surface Temp ⁰ (C/F) Min/Max / : / : / : / : Dew Point Temp ⁰ (C/F) : : : : Wind Direction/Speed : : : : Weather Conditions: : : : : | | | | | | | | | | | | | | | | | |
| Surface Preparation | | | | | | Application | | | | | | | | | | | | | | | | | |
| Start Time: _____ Finish Time: _____ Est Sq/ft: _____ <input type="checkbox"/> Solvent Clean <input type="checkbox"/> Hand Tool <input type="checkbox"/> Power Tool <input type="checkbox"/> HP Wash PSI _____ <input type="checkbox"/> Other _____ <input type="checkbox"/> Abrasive Blast <input type="checkbox"/> Abrasive Type _____ <input type="checkbox"/> Sample <input type="checkbox"/> Blast Hose Size _____ <input type="checkbox"/> Nozzle Size / PSI _____ <input type="checkbox"/> Air Supply CFM _____ <input type="checkbox"/> Air Supply Cleanliness <input type="checkbox"/> Water/Oil Trap Check <input type="checkbox"/> Equipment Condition Check | | | | | | Start Time : _____ Finish Time : _____ Est. Sq/ft. : _____ <input type="checkbox"/> Primer <input type="checkbox"/> Intermediate <input type="checkbox"/> Topcoat <input type="checkbox"/> Touch-up Generic Type: _____ Qty Mixed: _____ Manuf.: _____ Mix Ratio: _____ Prod Name: _____ Mix Method: _____ Prod #: _____ Strain/Screen: _____ Color: _____ Material Temp: _____ ⁰ F Kit Sz/Cond.: _____ Sweat-in Time: _____ Min/Hrs Shelf Life: _____ Pot Life: _____ Min/Hrs | | | | | | | | | | | | | | | | | |
| Surface Cleanliness & Profile Measurement | | | | | | Batch #'s | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Job Specification <input type="checkbox"/> SSPC/NACE - SP- _____ <input type="checkbox"/> SSPC/NACE Spec / Visual Stds <input type="checkbox"/> _____ Profile Check: _____ <input type="checkbox"/> Disc <input type="checkbox"/> Tape <input type="checkbox"/> Gauge <input type="checkbox"/> Specified _____ mils avg. / Achieved _____ mils <input type="checkbox"/> Surface effect on DFT Gauge/BMR _____ mils | | | | | | Reducer #: _____ Qty Added: _____ Pt/Qt/Gal % by Vol: _____ % Specified WFT Avg: _____ Mils Achieved WFT Avg: _____ Mils <input type="checkbox"/> Airless/Conv. Spray <input type="checkbox"/> Brush <input type="checkbox"/> Roller <input type="checkbox"/> Other _____ Pump Pot _____ Hose Dia. _____ Air Check _____ Ratio/Size _____ Hose Lng. _____ SEP/Trap _____ GPM/CFM _____ Spray Gun _____ Filter _____ PSI _____ Tip Sz. _____ Agitator _____ | | | | | | | | | | | | | | | | | |
| Dry Film Thickness | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Gage Type / Model</th> <th>Gage Serial #</th> <th>Gage Calib. Verified</th> <th>Spec Avg. DFT</th> <th>Total Avg DFT</th> <th>DFT Last Coat</th> <th>DFT This Coat</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> | | | | | | Gage Type / Model | Gage Serial # | Gage Calib. Verified | Spec Avg. DFT | Total Avg DFT | DFT Last Coat | DFT This Coat | | | | | | | | Inspector's Signature _____ Date _____ | | | |
| Gage Type / Model | Gage Serial # | Gage Calib. Verified | Spec Avg. DFT | Total Avg DFT | DFT Last Coat | DFT This Coat | | | | | | | | | | | | | | | | | |
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SECTION 13 34 20 - POST-FRAME WOOD BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL DESCRIPTION OF BUILDING SYSTEM

- A. Primary Framing:
 - 1. Posts attached to cast-in-place concrete post foundations; connection of posts is to be designed by post-frame wood building system designer.
 - 2. Roof trusses in main span.
- B. Post-Frame Type:
 - 1. Clear span post-frame with trusses connected directly to posts.
- C. Primary dimensions:
 - 1. As indicated in Construction Documents.
- D. Metal Roofing.
- E. Metal Wall Panels, Hardy Plank or Smart Wood (Or Equivalent) Wall Panels
- F. Metal Liner Panels for soffits, ceilings and wall applications as indicated.
- G. Gutters, Downspouts, metal trim, flashing
- H. Roof and wall insulation including radiant barriers, vapor barriers and building wrap.

1.3 REFERENCES

- A. AWC (NDS)- National Design Specification for Wood Construction
- B. IBC-International Building Code with Indiana Administrative Code Amendments.
- C. ANSI/ASCE 7 — Minimum Loads for Buildings and Other Structures.
- D. ANSI/TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction.
- E. APA- Engineered Wood Construction Guide.
- F. APA PDS 04-Panel Design Specification.
- G. APA-Roof Sheathing Fastening Schedules for Wind Uplift.

- H. ASAE EP 484 Diaphragm Design of Metal-Clad, Post-Frame Rectangular Buildings. ASABE Standards. St. Joseph, MI.
- I. ASTM A 123-Specification for Zinc (Hot-dip Galvanized) Coating on Iron and Steel Products
- J. ASTM A 153-Specification for Zinc (Hot-dip Galvanized) Coating on Iron and Steel Hardware.
- K. ASTM A 653/A 653M —Specification for Steel Sheet, Zinc-coated Galvanized or Zinc-iron alloy-coated Galvanealed by the Hot-dip Process
- L. ASTM F 1667 — Specification for Driven Fasteners: Nails, Spikes and Staples.
- M. AWPA UI - USE CATEGORY SYSTEM: User Specification for Treated Wood Products.
- N. BCSI. Building Component Safety Information. Guide for Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.
- O. ANSI/AITC A 190.1 — Structural Glued Laminated Timber
- P. NFBA - Accepted Practices for Post Frame Building Construction: Framing Tolerances.
- Q. NFBA Accepted Practices for Post-Frame Building Construction: Metal Panel and Trim Installation Tolerances
- R. ACI 318- Building Code Requirements for Structural Concrete.

1.4 POST-FRAME WOOD BUILDING SYSTEM PERFORMANCE

- A. The building shall be designed by the Post-Frame Wood Building System supplier's Designer of Record as a complete system. All structural members and connections shall be the responsibility of the Designer of Record. All components of the system shall be specified by the Designer of Record. This includes, but is not limited to, components such as post connections to foundations, post concrete foundations, primary framing, secondary framing, and lateral bracing.
- B. Delegated Design: Design post-frame building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Post-frame building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in referenced Building Code and associated standards.
 - 1. Design Loads: As required by 2014 Indiana Building Code (2012 International Building Code with Indiana Amendments).

2. Deflection Limits: Design post-frame building system assemblies to withstand design loads with deflections no greater than the following:
 - a. Purlins: Vertical deflection of $1/240$ of the span.
 - b. Girts: Horizontal deflection of $1/240$ of the span.
 - c. Metal Roof Panels: Vertical deflection of $1/240$ of the span.
 - d. Metal Wall Panels: Horizontal deflection of $1/240$ of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 3. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - a. Lateral Drift: Maximum of $1/500$ of the building height.
 4. Metal panel assemblies shall withstand the efforts of gravity loads and stresses within limits and under conditions indicated according to ASTM E 1592.
- D. Seismic Performance: Post-frame building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- E. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. in) of wall area when tested according to ASTM E 283 at the following test-pressure difference.
1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
1. Positive Preload Test-Pressure Difference: Greater than or equal to 6.4 lbf/sq. ft. (307 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
- H. Water Penetration for Metal Wall Panels under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- I. Water Penetration for Metal Wall Panels under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).
1. Water Leakage: Uncontrolled water infiltrating the system or appearing on systems normally exposed interior surfaces from sources other than

condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

- J. Minimum Net Free Area: Provide Soffit vents for this project that will provide a minimum of 1/600 of free net area of the floor area below the attic separation walls
- K. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- L. Thermal Performance: See the drawings for the required R values.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For the following post-framed building system components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Structural-Framing Drawings: Show complete erection of primary and secondary framing; include provisions for openings. Indicate all connections. Include transverse cross-sections.
 - 2. Show fabrication and installation details for trusses.
 - a. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - b. Indicate sizes, stress grades, and species of lumber.
 - c. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - d. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - e. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - f. Show splice details and bearing details.
 - 3. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items, equipment supports, pipe supports and penetrations and lighting fixtures.
 - b. Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1- 1/2 inches per 12 inches (1 :8):
 - a. Flashing and trim
 - b. Gutters.
 - c. Downspouts.
 - d. Louvers.

- B. Product Data: For wood-preservative-treated lumber, metal-plate connectors, metal truss accessories, and fasteners. For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
 4. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Structural-steel-framing system.
 - b. Metal roof panels.
 - c. Metal wall panels.
 - d. Metal liner panels - Pre-finished (Wall and Ceiling)
 - e. Insulation and vapor retarder facings.
 - f. Flashing and trim.
 - g. Accessories.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
1. Metal Panels: Nominal 12 inches (300 mm) long by actual panel width. Include fasteners, closures, colors and other exposed panel accessories.
 2. Flashing and Trim: Nominal 12 inches (300 mm) long. Include color, fasteners and other exposed accessories.
 3. Vapor-Retarder Facings: Nominal 6-inch- (150-mm-) square Samples.
 4. Accessories: Nominal 12-inch- (300-mm-) long Samples for each type and color of accessory.
- D. Delegated-Design Submittal: For post-framed building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Indiana responsible for their preparation.
1. Indicate assembly dimensions, locations of structural members, connections, attachments, openings, cambers and loads; wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage, installation and; framing anchor bolt settings, sizes, and locations from datum and foundation loads.
 2. For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- E. Field quality-control reports.
- F. Material Test Reports: For each of the following products:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- H. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated lumber.
 - 2. Metal-plate connectors.
- I. Qualification Data: For qualified builder and professional engineer
- J. Maintenance Data: For metal panel finishes to include in maintenance manuals.
- K. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Post-framed building systems designer:
 - 1. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

- E. The builder shall have specialized experience in the construction of post-frame building systems for a period of at least 5 years.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Metal-plate connected wood trusses:
 - 1. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - a. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - b. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - c. Provide for air circulation around stacks and under coverings.
 - 2. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.
- B. Lumber:
 - 1. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings
- C. Metal Panels:
 - 1. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
 - 2. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
 - 3. Stack metal panels horizontally on platforms or pallets, covered with suitable weather tight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.8 WARRANTY

- A. The post-frame contractor shall provide a workmanship warranty of 2 year(s) for prevention of roof leaks, and other water infiltration.
- B. Component installation shall be warranted by the installer for 20 year(s).
- C. Material suppliers shall provide manufacturers' standard material warranties.

PART 2 PRODUCTS

2.1 POSTS:

- A. Wall posts may be Solid sawn or Glued-laminated structural wood products.
- B. Portions of wood posts less than 8 in. above grade must be:
 - 1. Protected with pressure preservative chemical treatments to retention levels for Use Category UC4B or better per AWP-1.
- C. All connection hardware below grade and 8 in. or less above grade shall be hot dipped galvanized per ASTM 153 to meet requirements of preservative chemical treatments applied to lumber.

2.2 WALL GIRTS:

- A. Wall girts are solid sawn products.
- B. Wall girts shall satisfy the wind load requirements of Section 1 .4.H plus any additional lateral loadings exerted by stored materials acting directly on the wall sheathing.
- C. All wall girts less than 8 in. above grade must be pressure preservative treated with preservative chemical treatments and to retention levels for Use Category UC4B or better per AWP-1.
- D. Wall girts are placed directly on the outside face of wall columns.
- E. Wall girts are attached to the posts with fastener schedules specified by the post-framed building system designer.
- F. All connection hardware 8 in. or less above grade shall be hot dipped galvanized per ASTM 153 to meet requirements of preservative chemical treatments applied to lumber.

2.3 WALL SHEATHING:

- A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weather tight installation.
- B. Exterior Wall System: Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs.
 - 1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, 19 (Z75) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class 150 (Class

- AZT4 !50) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: 29 gauge, minimum.
 - b. Exterior Finish: Factory applied polyvinylidene fluoride finish. The coating shall be a nominal 0.050 mm (2 mil) thickness consisting of a baked-on topcoat of not less than 0.018 mm 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.025 mm (1.0 mil) thickness.
 - 1) Color: As selected by the Architect.
 - c. Interior Finish: The interior color finish shall consist of a 0.5 mil (0.013 mm) thick prime coat, color: white.
2. Panel Profile: G-Rib
 3. Panel Coverage: 36 inches.
 4. Panel Height: 0.75 inches.
- C. Wall sheathing shall satisfy the wind load requirements of Section 1 .4.H plus any additional lateral loadings exerted by materials acting directly on the wall sheathing.
- D. Wall sheathing consists of ribbed steel panels attached to outside edge of wall girts in accordance with manufacturer's specifications and post-frame building systems designer.
- E. Interior Wall and Ceiling System: Corrugated or Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels on MR 5/8" Gyp. Bd.
1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, I "I" (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class .47.30 (Class AZM 150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 29 gauge, minimum.
 - b. Exterior Finish: Factory applied polyvinylidene fluoride finish. The coating shall be a nominal 0.050 mm (2 mil) thickness consisting of a baked-on topcoat of not less than 0.018 mm 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.025 mm (1.0 mil) thickness.
 - 1) Color: As selected by the Architect.
 - c. Interior Finish: The interior color finish shall consist of a 0.5 mil (0.013 mm) thick prime coat, color: white.
 2. Panel Profile: Corrugated or G-Rib
 3. Panel Coverage: 36 inches.
 4. Panel Height: 0.75 inches.

2.4 PRIMARY ROOF FRAMING:

- A. All roof framing shall satisfy the load requirements of Section 1.4.C through 1.4.I except dead load for purlins only includes contributions from the purlins and sheathing and other roof coverings.
- B. The primary roof framing shall consist of metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated
 - 2. Maximum Deflection Under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/240 of span.
- C. Comply with applicable requirements and recommendations of the following publications.
 - 1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
 - 2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
 - 3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 4. D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and it's "Supplement."

2.5 ROOF PURLINS:

- A. Roof purlins shall satisfy the load requirements of Section 1.4.C through 1.4.H except dead load for purlins includes only the contributions from the purlins, sheathing, and other roof coverings.
- B. Roof purlins shall be Solid sawn structural wood products.
- C. Roof purlins shall be placed directly on the top of trusses with strong axis oriented per shop drawings.
- D. Roof purlins shall be attached to the truss with fastener types and schedules per the designer of record.

2.6 ROOF SHEATHING:

- A. Roof System: Manufacturer's standard metal roof panels.
- B. All roof sheathing shall satisfy the load requirements of Section 1.4.C through 1.4.H except dead load only includes contributions from the sheathing and other sheathing coverings.

1. Uplift Rating: UL 90.
- C. Metal Roof Panels. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs.
1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, (t) (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, (t) (Class AZM 150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 29 gauge, minimum.
 - b. Exterior Finish: Factory applied polyvinylidene fluoride finish. The coating shall be a nominal 0.050 mm (2 mil) thickness consisting of a baked-on topcoat of not less than 0.018 mm (0.7 mil) dry film thickness and the paint manufacturer's recommended primer of not less than 0.025 mm (1.0 mil) thickness.
 - 1) Color: As selected by the Architect.
 - c. Interior Finish: The interior color finish shall consist of a 0.5 mil (0.013 mm) thick prime coat, color: white.
 2. Panel Profile: G-Rib
 3. Panel Coverage: 36 inches.
 4. Panel Height: 0.75 inches.

2.7 GLASS-FIBER BLANKET INSULATION

- A. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category I (membrane is a vapor barrier).
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville.
 - d. Knauf Insulation.
 - e. Owens Corning.
- B. Reinforced-Foil-Faced, Glass-fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.8 LOOSE-FILL INSULATION

- A. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type I for pneumatic application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

- B. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

2.9 RADIANT BARRIERS

- A. Radiant Barriers: ASTM C 1313 and as follows:
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. EcoFoil; Foil-Single Bubble-Foil.
 - b. Innovative Insulation, Inc.; TempShield Single Bubble Foil.
 - c. RadiantGuard; Reflex-Air Single Bubble.
 2. Sheet Construction: One layer of a bubble wrap insulation material laminated between two layers of metalized film providing a minimum thermal resistance of R1.0.
 3. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of 5 and 10, respectively.
 4. Tear Resistance (ASTM D882): 80.4 lb/in width, machine direction.
 5. Water-Vapor Transmission: 5 perms or greater.

2.10 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
 - b. DuPont (E.I. du Pont de Nemours and Company); Tyvek CommercialWrap.
 - c. Ludlow Coated Products; Barricade Building Wrap.
 - d. Pactiv, Inc.; GreenGuard Classic Wrap.
 - e. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
 - f. Reemay, Inc.; Typar HouseWrap.
 2. Water-Vapor Permeance: Not less than 75 perms (4300 ng•/Pa x s x sq. m) per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 3. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.11 VAPOR RETARDERS

- A. Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim

and weighing not less than 25 lb/100 sq. ft, (12 kN/100 sq. m), with maximum permeance rating of 0.05 (0.7 Jan-in (2.9 ug Pa x s x sq. in)).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Raven Industries Inc.; DURA-SKRIM 6WW.
 - b. Reef Industries, Inc.; Griffolyn T-65.
2. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.12 DOORS AND FRAMES

- A. See Specifications under Division 8.

2.13 WINDOWS

- A. See Specifications under Division 8.

2.14 ACCESSORIES

- A. General: Provide accessories as standard with post-framed building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge vents, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weather tight construction.

6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch (25-mm) standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, silks, comer units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-min-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weather tight construction.
- D. Flashing and Trim: Formed from minimum 22 gauge metallic-coated steel sheet or aluminum- zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, comers, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Formed from minimum 22 gauge, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from minimum 22 gauge, metallic-coated. steel sheet or aluminum-zinc alloy- coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2438-min-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Formed from same material as roof panels and finished to match metal wall panels. Fabricate in minimum 10-foot- (3-m-) long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

- a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex- head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex- head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
 - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4- mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 3. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene- compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class. and use classifications required to seal joints in metal panels and remain weather tight; and as recommended by metal building system manufacturer.

2.15 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- B. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspection: Before start of installation, contractor shall carefully inspect installed Work of other trades affecting construction of the post frame building. Verify that all such

work is complete to the point where installation of the post-frame building may properly commence.

1. Verify that the work of this section may be installed in accordance with all applicable codes and regulations, and with original design as shown and indicated on the shop drawings approved by the designer of record.
- B. Discrepancies: In the event of a discrepancy, installer shall immediately notify the designer of record. Installation shall not proceed until discrepancies and/or unsatisfactory conditions have been fully resolved and/or approved as agreed by the designer of record and the installer.

3.2 PREPARATION:

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION:

- A. General: Work shall proceed in accordance with contractor's current, written instructions and as per design specifications and reviewed shop drawings for erection of post-frame building systems.
- B. Install all roof and wall structural elements, building components, and accessories as shown in the reviewed design shop drawings or in component supplier instruction sheets
 1. Install all connections between indicated structural components per shop drawings.
- C. Install purlins and wall girts in the orientation shown in the shop drawings.
- D. Handle, install and brace all trusses during construction according to TPI's, HIB-Post Frame document.
- E. Install required roof bracing as shown on the shop drawings
- F. If applicable, install individual web member permanent lateral restraint at the locations shown on the sealed truss shop drawings.
- G. If applicable, install diagonal bracing to appropriate individual web members for permanent lateral restraint as specified by post-framed building designer.

- H. Install permanent wind bracing in the wall system as shown on the shop drawings.
- I. Install all framing components to within tolerances recommended in the NFBA Framing Tolerances standard, "Accepted Practices for Post Frame Building Construction: Framing Tolerances."
- J. Provide temporary wall bracing during construction as recommended by the post-framed building designer
- K. Do not field cut or modify structural members without approval of the post-framed building designer or the Architect

3.4 METAL PANEL INSTALLATION, GENERAL:

- A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- B. General: Install all metal panel and metal trim components to within tolerances recommended in NFBA's Cladding Tolerances standard, "Accepted Practices for Post-Frame Building Construction: Metal Panel and Trim Installation Tolerances."
 - 1. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 2. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 - 3. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 4. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 5. Locate and space fasteners in uniform vertical and horizontal alignment.
 - 6. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
 - 7. Lap metal dashing over metal panels to allow moisture to run over and off the material.
 - 8. Fasteners: Use stainless-steel fasteners.
 - 9. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.

- b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- 10. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- 11. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - a. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 - b. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION:

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Tapered-Rib-Profile, Exposed-Fastener Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs.
 - 1. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
 - 3. Provide metal closures at rake edges and each side of ridge caps.
 - 4. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels 4 inches (102 mm) minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
 6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in predrilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 in), nonaccumulative, on level, plumb, and on location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.7 THERMAL INSULATION INSTALLATION

- A. General: Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
 - 1. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
 - 2. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
 - 3. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
 - 1) With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
 - 2) b. Concealed Installation: Kraft-faced, glass-fiber blanket insulation may be used in concealed spaces where insulation is installed behind and in substantial contact with the unexposed surface of the wall finish.
 - 3) Exposed Installation: Reinforced-foil-faced, glass-fiber blanket insulation with a flame-spread index of 25 or less must be used where insulation will be left exposed above and below the ceiling.
- C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
- D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/C ft. (40 k CPI. 1T1).

3.8 INSTALLATION OF RADIANT BARRIERS

- A. Install sheet radiant barriers according to ASTM C 1158.

3.9 WATER-RESISTIVE BARRIER INSTALLATION

- A. Building Wrap: Comply with manufacturer's written instructions.
 1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

3.10 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
 1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.11 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant

- coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
 - 4. All roof and wall accessories to be installed weather tight.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.
 - 3. Downspouts to utilize splash blocks or underground drainage system as indicated on the drawings
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.12 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures

END OF SECTION 13 34 20

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SECTION 25 13 00 - INSTRUMENTATION AND CONTROLS

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. This project includes but is not limited to the following:
 - 1. Main SCADA System Control Panel (MSCP)
 - 2. Doghouse Control Panel
 - 3. Motor Control Panel
 - 4. System Pressure Transducer
 - 5. Transfer Pit Float Switches
 - 6. Chemical Feed Operations
 - 7. High Service Pump Control/Monitoring
 - 8. Lake Pump Control/Monitoring
 - 9. Transfer Pump Control/Monitoring
 - 10. Miscellaneous Monitoring and Alarms
 - 11. HMI Color Touchscreen Graphics Development
 - 12. Matching remote HMI in office
- B. Instrumentation & Control General Descriptions
 - 1. The Instrumentation and Control System shall include all work necessary to monitor and control processes within this facility as described herein, unless otherwise noted.
 - 2. There shall be Remote Telemetry via cell modem for monitoring and controlling the lake pumps. Cell modems shall be setup with private networking in coordination with owner's cell phone provider.

1.02 PRE-CONSTRUCTION SUBMITTALS

- A. Submit the following:
 - 1. Shop drawing submittals for each group of equipment
 - 2. Equipment manufacturing/panel fabrication
 - 3. Shop drawings, indicating performance and physical data of the equipment specified herein.
 - 4. Manufacturer's installation instructions.
 - 5. Provide mounting details for field mounted equipment.
 - 6. Manufacturer's operation and maintenance instructions.
- B. Physical requirements of submittals shall be as follows:
 - 1. Submittals shall be submitted as PDFs.
- C. Shop drawings shall include, but not be limited to, the following:
 - 1. Instrument index, which shall include instrument tag numbers, instrument description and instrument calibrated ranges.
 - 2. Typewritten specification sheets, which shall include manufacturer's names and complete catalog numbers.
 - 3. Cut sheets and catalog information, which shall contain equipment specifications, dimensions, wiring and piping drawings, and installation and mounting details.

4. Loop drawings, which shall contain, but not be limited to, the following information:
 - a. Loop numbers and instrument tag numbers
 - b. Individual loop component locations
 - c. Actual equipment wiring terminal designations, point to point wiring, and cable shield terminations
 - d. Wire type, size and identification number
 - e. Signal types (e.g., 120 Volt AC, 4-20 mA DC, pulse frequency, 3-15 psig, etc.)
 - f. Contact orientations (e.g., normally open, normally closed, etc.)
 - g. Equipment grounding requirements
 - h. Sources of loop power, or power supply identifications
 - i. Signal boosters, interposing relays and shunt resistors
5. Instrument and control panel layout drawings, which shall include, but not be limited to, the following:
 - a. Bill of materials
 - b. Front panel layout drawings
 - c. Swing-out panel layout drawings
 - d. Internal panel layout drawings
 - e. Internal wiring diagrams, including wire type, size and identification number
 - f. Terminal block layout drawings
 - g. Nameplate lists
 - h. Color schedules and samples
6. Elementary control diagrams.
7. Other descriptive information that will assist the Engineer with approval.

1.03 RECORD DRAWINGS (AS-BUILT) SUBMITTALS

- A. Record drawings (as-built) submittals shall be as specified in the General Conditions, further described below:
- B. The record drawings submittals shall consist of, but not be limited to, the following:
 1. Submit one set to the Engineer and one set to the owner of corrected contract documents. The original contract documents shall be marked to reflect 'as-built' conditions. Corrections shall be made in red.
 2. Submit one set to the Engineer and one set to the Owner printer outputs of the final configuration or programs of all programmable controller-based equipment.
 3. Submit to the Owner standard magnetic storage devices, such as CD/DVD disks and USB thumb drives, of all programmable controller-based equipment software and programs.
 4. Submit original licensed copies and original documentation for all software. All software licenses shall be in Owner's name.

1.04 OPERATION AND MAINTENANCE MANUALS

- A. Prepare and furnish Operation and Maintenance Manuals of the system, which shall be submitted to the Engineer prior to operator training described below. Provide four (4) bound hard copy sets and one (1) USB with complete electronic copy in pdf format.

- B. The Operation and Maintenance Manuals shall include, but not be limited to, the following:
1. Approved shop drawings amended by approved change orders and as-built conditions.
 2. Manufacturer supplied operating and installation manuals.
 3. Detailed procedures and instructions on the operation, removal, installation, adjustment, calibration, and maintenance of each component provided under this contract.
 4. As-built control panel and enclosure drawings, including termination drawings, input/output (I/O) wiring diagrams, and panel bill of materials.
 5. List of recommended spare parts, which shall include complete catalog numbers
 6. List of local or the nearest manufacturer approved repair and service centers.
 7. Complete documentation of the PLC and VFD program.

1.05 OPERATOR TRAINING

- A. Provide operation and maintenance training of the Owner's personnel. This training shall include, but not be limited to, the following:
1. The review of the Operation and Maintenance Manuals prepared and furnished by the System Integrator.
 2. The review of 'as-built' panel layout drawings and wiring diagrams.
 3. Hands-on training in the operation of each instrument and each loop.
 4. Hands-on training in the maintenance, removal, and reinstallation of each instrument and each loop.
 5. Hands-on training in the programming or configuration of all programmable microprocessor-based instruments. This does not include the PLC system/OMNISITE system.
- B. The Contractor shall bear all expenses associated with the operator training activities, including labor, transportation and material costs.

PART 2 – PROCESS DESCRIPTION

2.01 GENERAL

- A. Where indicated, each motor will have the following pilot and control devices:
1. HAND-OFF-AUTO selector switch.
 - a. In HAND the equipment shall run.
 - b. In OFF the equipment shall remain off.
 - c. In AUTO, the equipment shall be controlled by the Omnisite or backup floats.
 2. Green LED RUN light.
 3. Amber ALARM light.
 4. If a VFD is used, then include remote keypad (HIM module).
- B. The new main PLC control panel (MSCP) and Doghouse PLC control panel shall communicate via cell modems. The SCADA system shall have a local touchscreen HMI which shall display all parts of the system functionality and alarming. Text only information is not acceptable. Graphically

represent all functions of the system with an easy-to-use menu system. Graphics that do not represent proper operation, process functionality, ease of use and operator interface shall be rejected.

- C. All provided variable frequency drives (VFD) shall have Ethernet/IP connectivity to the PLC for monitoring only. Hard wired control and monitoring shall be as shown on drawings. Each VFD shall have a soft programmed Auto/Manual in the PLC that can be selected by the operator. When in Auto, the VFD shall follow commands from the PLC as described herein. In Manual, the operator shall have the ability to manually start/stop each motor and provide a speed setpoint (100% as default) from the SCADA system. In Hand mode, the VFD shall start and run at a predefined speed.
 - 1. VFD information to be monitored at a minimum via the Ethernet connection (this information shall be available as a popup when a VFD or motor symbol on the display is pressed):
 - a. VFD and Motor info
 - b. Run status
 - c. Fault status (included parameter and a lookup table so operator can easily identify drive fault problem)
 - d. Motor torque
 - e. Frequency and percentage (drive speed)
 - f. Voltage (each leg)
 - g. Current (each leg)
 - h. Overload status
- D. The new main PLC control panel HMI shall have trending for all flows, levels, temperatures and pressures of the system.
- E. The HMI shall have an alarm summary screen.
- F. The HMI shall have pop-up screens for all pump, actuators and other equipment controls.
- G. A small PLC control panel shall be provided at the 'Doghouse' where the Lake Pump motor starters are located. The Plant PLC will communicate via the Sierra Wireless RV50X cell modems. Existing Lake Pumps shall be controlled and monitored via this connection.
- H. Flow rates from the new flow meters shall have the following and be represented on SCADA graphics:
 - 1. Current Flow Rate in GPM
 - 2. Total Accumulated Flow in MGD
 - 3. Current Hour Total in Gallons
 - 4. Previous Hour Total in Gallons
 - 5. Current Day Total in MGD
 - 6. Previous Day Total in MGD
 - 7. Current Week Total in MGD
 - 8. Previous Week Total in MGD
 - 9. Current Month Total in MGD
 - 10. Previous Month Total in MGD

11. Current Year Total in MGD
12. Previous Year Total in MG

2.02 PROCESS CONTROL DESCRIPTIONS

- A. For programming the system, System Integrator shall include 40 hours of programming time to alter the following programming to what the owner/operator wants to include or change. All procedure changes and programming changes that deviate from this specification shall be documented by the System Integrator and provided to Engineer of record.
- B. High Service Pump Operation
 1. The high service pumps shall be used to fill the ground storage tank. The storage tank level shall be determined by the plant system pressure. The pressure sensor shall be monitored continuously by the PLC and the input signal shall be averaged over a two minute period to create a control level signal. The control level signal shall be used to control when the high service pumps are called to run.
 2. Each high service pump shall have a soft auto/manual selection and shall operate as indicated above. Each high service pump shall have a VFD which will convert 240VAC single phase to 240VAC three phase.
 3. The VFD units shall be enabled to operate as described above.
 4. The high service pumps shall operate on a lead/lag scenario based on storage tank level setpoints.
- C. Chemical Feed System
 1. The chemical feed system shall have four separate chemical systems:
 - a. Sodium Hypochlorite (NaOCl); pre and post feed. Pre feed shall be controlled by the rawwater flow rate and the post shall be controlled by the finished water flow rate while in auto.
 - b. Sodium Hydroxide (NaOH). Controlled by the rawwater flow rate while in auto.
 - c. Sodium Permanganate (NaMnO₄). Controlled by the rawwater flow rate while in auto.
 - d. Aluminum Chlorohydrate/Flocculant (Al nCl 3n-m). Controlled by the rawwater flow rate while in auto.
 2. Each chemical feed system shall have a feed pump. The feed pump shall be as stated on Sheet D301 of contract drawings.
 3. The PLC shall have a soft manual/auto for each feed pump. When in manual, the operator shall be able to set the percentage of speed the pump will dose. While in auto, the feed pump shall operate from a process variable and adjust the dose speed based on a PID loop control output. The PLC shall monitor the run status and failure of each feed pump.
 4. For the sodium hypochlorite feed, there is a free chlorine residual analyzer. The finished water flow rate shall be the coarse adjust for post feed with the analyzer signal being the fine adjust while in automatic. The pre feed shall be controlled by the raw water flow rate.

5. Each feed rate, while in automatic, shall have an up and down arrow adjustment to increase or decrease the output by 1% increments so the operator may adjust the final settings to the feed pumps.

D. Mix Tank Mixer

1. The mixer shall have a VFD to vary the speed. The mixer shall not operate while the Lake pumps are in operation. The mixer shall work on a batch sequence scenario.
2. A control station with a cycle mode active pilot light and a mix cycle start pushbutton shall be located at the mixer.
3. The operator shall start this cycle by pushing the start cycle button at the mixer sending a start signal for the mixer through the PLC. The operator shall push this button shutting off the Lake pumps if they are running. The pumps shall be disabled from running during this cycle. The operator shall manually close the valve between the mixing tank and the sedimentation tank. The mixer shall start a flash cycle for 10 minutes by default at 100% speed. After this time, the mixer shall reduce speed by 50% and mix for an additional 60 minutes.
4. All timers and time periods shall be adjustable by the operator via the HMI.

E. Transfer Pump Operation

1. The transfer pumps shall be operated via float switches for automatic/float mode and be able to operate in soft manual/auto mode as described above while in PLC mode. Each pump shall also be available for 'FLOAT' mode by a selector switch on the Main PLC Control Panel (MSCP).
2. Floats shall activate a control relay and the relay shall have A and B contacts which shall go to PLC digital input and Float mode controller. The controller and PLC shall be able to operate independently depending on mode selector switch position.
3. While in float mode, the PLC shall be ignored and each pump shall be operated by a pump controller similar to SJE DPC-4F. This controller shall only be powered while in float mode. See wire diagrams.
4. Pumps shall be setup to alternate each call cycle for lead.

F. Alerts, Alarms and Telemetry

1. Alerts, Alarms, and Telemetry shall be accessible to personnel as assigned by owner via cell modem connectivity to the Maple Systems display.
2. The Maple System HMI shall be setup to send out emails and text messages for alarm notifications.

PART 3 – EXECUTION

3.01 GENERAL

- A. The Contractor shall provide all materials and work necessary for a complete and functioning I&C system and shall have full coordination responsibility of the electrical, mechanical, and structural work as specified herein and as shown on the drawings. The Contractor shall ensure that the instrumentation and control systems work is properly interfaced with equipment and other work furnished under other divisions of the contract documents.

- B. The Contractor shall install, make final connections to, adjust, test, and start-up the complete instrumentation and control system utilizing the technical service and advice of the various equipment and instrument manufacturers.

3.02 INSTALLATION

A. General

- 1. Installation shall be in strict compliance with individual equipment manufacturer's instructions.

B. Installation Hardware

- 1. All nuts and bolts shall be plated steel.
- 2. Exterior support channels shall be stainless steel; Interior support channels shall be galvanized steel unistrut channels with plated steel hardware.
- 3. All contact surfaces between dissimilar metals shall be gasketed to prevent galvanic reaction.

3.03 EQUIPMENT IDENTIFICATION AND TAG NUMBERS

A. All apparatus, control equipment, and instruments, both panel and field mounted, shall be plainly identified, using the following methods:

- 1. Pipe-mounted instruments shall be provided with embossed stainless-steel tags, which shall be attached to the instruments by means of stainless-steel wire or tie wrap.
- 2. Wall, plate, or panel mounted instruments shall be provided with engraved laminated plastic tags, which shall be mounted above, or below instruments. The plastic tags shall be mounted at eye level and shall be visible from a minimum distance of 20 feet. Lettering shall be black on white background.

B. Tag numbers and engraved or embossed text shall be as shown on the drawings, or as approved by the Engineer during shop drawing approval.

C. Tag numbers shall conform to the current Instrument Society of America (ISA) Standards, unless otherwise noted, which shall consist of a multi-character prefix, followed by a loop number. Tag numbers shall be as indicated on the drawings.

3.04 TESTING AND CALIBRATION

A. Test all analog loop zeroes and spans by disconnecting wiring at each transmitter and substituting an approved 4-20madc generator. Adjust the indicators and receiving instruments to indicate the correct value, correlated to the simulated current signal.

B. Test all annunciator points by placing jumpers across normally open contact inputs, or by disconnecting wiring on normally closed contact inputs.

3.05 COMMISSIONING

A. This activity shall consist of individual loop/instrument tests, overall systems test, and Operator training.

1. Loop Operation Test: The objective is to demonstrate that the instrumentation and control system individual instruments are ready to be placed into permanent operation. Each loop shall be tested and demonstrated.
2. Substantial completion of the system shall not be approved until satisfactory completion of commissioning.

3.06 WARRANTY

- A. The Instrumentation and Control System shall be fully warranted and guaranteed from defect for a one-year period, beginning at the date of substantial completion.
- B. During the warranty period adjust, recalibrate, repair, replace and otherwise place back into service any instrument and any item(s) that may require service, including software, at no additional cost to the Owner for any reason.
- C. During the warranty service, provide unlimited on-site software and operation support, at no additional cost to the Owner for any reason.
- D. Respond to a call for service within 24 hours.
- E. At approximately six months completion of the warranty period, visit the facility and perform routine diagnostics and tests to determine on-going operation and performance of the I & C system within the project requirements. Make all repairs and adjustments necessary at no additional cost to the Owner for any reason. Conduct additional "follow-up training" to assist the Owner in operation and maintenance and to address any operational concerns that may have become known after six months of operation.

END OF SECTION

SECTION 25 30 00 - FIELD MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work required under this section includes the provision, installation, start-up, testing and calibration of all field mounted instruments required for this project.
- B. The types of field mounted instruments required for this project include the following:
 - 1. Level (float) Switches.
 - 2. Pipe Mounted Pressure Sensor.
 - 3. Magnetic Flow Meters.
 - 4. Radar Level Transmitter.
 - 5. Chlorine Residual Analyzer.
 - 6. Turbidity Analyzer.

1.02 SUBMITTALS

- A. Prepare and submit shop drawings and descriptive data for each instrument and information regarding field installation of each instrument.

PART 2 – PRODUCT

2.01 GENERAL

- A. For each field mounted instrument, provide a complete assembly with all required components, enclosures suitable for the environment and location, fittings, mounting brackets, and other components and accessories as needed to form a complete system.
- B. Provide conduit, raceway accessories, wiring and connections necessary to place the instruments into service and necessary to interface the instruments to other equipment control panels, programmable controllers, and similar installations as required for the project.
- C. Include SPD units as specified elsewhere on the drawings.

2.02 FLOAT SWITCHES

- A. Operating Principle
 - 1. Direct acting, non-mercury float switch, encased in an ellipse shaped molded plastic float, connected to a factory installed cable. Float cable length to be determined by Contractor.
 - 2. The float shall be either pipe-mounted or suspended by its cable by means of a weight kit, as indicated in the equipment data.
- B. Specifications

1. Construction
 - a. Float material: High impact styrene
 - b. Mounting: 3/16" SS aircraft cable attached to a 25 pound concrete weight.
 - c. Strap float cables individually with PVC cable ties to aircraft cable. This shall allow removal of one float without affecting the other floats.
 - d. See Drawings for float switching elevations.
2. Electrical
 - a. The switch contacts shall be normally open or normally closed as indicated in the equipment data.
 - b. The switch contacts shall be rated 6 amperes, non-inductive at 120 Volts AC. Switches shall be normally closed unless noted otherwise.
 - c. The cable shall be two fine-stranded AWG #18 conductors in heavy-duty type SJO-W Neoprene jacketing. Standard length of the cables shall be 40 feet.
3. Performance
 - a. The switch shall make and break over a 1-inch level change.

2.04 PIPE MOUNTED PRESSURE SENSOR

A. Summary

1. Pressure transmitters shall be utilized in this application to continuously monitor system pressure on the discharge side of the high service pumps.
2. Section Includes: Pressure transducer with capacitive ceramic sensor for absolute and gauge pressure stable and resistant to overload.
3. Related Sections:
 - a. Control and Information System Scope and General Requirements
 - b. Powered Instruments, General

B. Submittals

1. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports
2. Product Data:
 - a. Dimensional Drawings.
 - b. Materials of Construction:
 - c. Measurement accuracy.
 - d. Range and range ability.
 - e. Enclosure Rating.
 - f. Classification Rating.
 - g. Power: Output options.

C. Quality Assurance

1. Manufacture instruments facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

D. Delivery, Storage, And Handling

1. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.
- E. Project Or Site Conditions
1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, process and ambient temperature, and humidity conditions.
- F. Maintenance
1. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.
- G. Calibration And Warranty
1. The manufacturer shall warranty the meters for manufacturing defects for a period of 18 months after shipment or 12 months after startup or 36 months if commissioned by a Factory field service representative or a manufacturer authorized service provider.
- H. Lifecycle Management
1. Equipment life cycle management shall be via web enabled system. System shall contain records related to initial factory settings, subsequent field calibrations, and full history of calibrations, service and software related to the specific device(s).
- I. Manufacturer
1. Endress+Hauser- Cerabar T PMC/PMP131
 2. Approved Equal
- J. Manufactured Units
1. The pressure transmitter shall be a loop-powered, two-wire device requiring a 11-30 VDC power input with a 4-20 mA DC output, superimposed on the power input lines, proportional to the calibrated span. The sensor shall have a + 5% zero point adjustment with no on site calibration required.
 2. The transmitter shall be housed in a compact 304SS enclosure and shall be designed and constructed to allow for direct mechanical mounting by the process connection, requiring no additional mounting hardware. The enclosure shall be NEMA4X with the option of NEMA 6P submersible if ordered with cable end.
 3. The transmitter shall utilize capacitance technology in conjunction with a dry cell (no oil fill) ceramic diaphragm design for pressures up to 500 PSIG/A. (Model PMC 131) Maximum deflection of the ceramic diaphragm shall not exceed 0.001 inch full scale movement to minimize diaphragm fatigue and the effects of build-up.
 4. The ceramic diaphragm shall be immune to damage due to vacuum and shall have an overpressure (proof) pressure rating of:
 - a. 150 PSI for URL of 0-15 PSI
 - b. 350 PSI for URL of 16-50 PSI
 - c. 600 PSI for URL of 51-300 PSI

- d. 850 PSI for URL of 301-500 PSI
- 5. Otherwise, the transmitter shall utilize Polysilicon sensor technology in conjunction with SS316L diaphragm design for pressures up to 6000 PSIG/A. The sensor shall be compatible with vacuum to 0.295"Hg absolute and shall have an overpressure (proof) pressure rating:
 - a. 60 PSI for URL of 15 PSI
 - b. 2400 PSI for URL of 500 PSI
 - c. 6000PSI for URL of 1500 PSI
 - d. 9000 PSI for URL of 6000 PSI
- 6. The accuracy shall be $\pm 0.5\%$ of full span including hysteresis and repeatability. The change of zero point between -4...+185 degrees F shall be no more than 1.5%. Long-term stability shall not exceed a 0.15% shift per year.

2.05 ELECTROMAGNETIC FLOW METER

- A. This specification covers an electromagnetic flow meter, as specified on the drawings, provide (2) magnetic flow meters; raw water and finished water. Each flow meter shall have the ability to be installed with zero pipe diameters (DN) upstream and downstream of installation point.
- B. Acceptable Manufacturer:
 - 1. E&H Promag W400 with integral electronics
 - 2. Krohne Optiflux 4000 with integral IFC-300 Convertor
 - 3. or approved equal
- C. Meter:
 - 1. Shall be a velocity sensing electromagnetic type flanged tube meter with sealed housing for 150 PSI working pressure.
 - 2. Meters shall have a digital indicator having a range of 0 – 200 GPM, shall be equipped with a 9 digit digital totalizer reading in units of US gallons, and shall be accurate within 0.5% of actual flow.
 - 3. The indicator display shall be direct reading. The system shall be designed for an ambient temperature range of -4o F to 125o F and a 120 VAC 60 Hertz power supply. The system power consumption shall be approximately 5 watts per inch diameter. The meter assembly shall operate within a range of 0.2 FPS to 32 FPS and be constructed as described herein.
 - 4. The sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the wastewater industry. The sensors shall be inherently submersible (IP68, NEMA 6P), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding. The meters shall be designed for measuring the material for which they are being specified.
- D. Meter Tube (Sensor):
 - 1. Shall be fabricated stainless steel pipe and use 150 lb. AWWA Class "D" flat face steel flanges (UM06) or 300 lb. AWWA Class "F" raised face steel flanges (UM08).

The internal and external of the meter tube shall be blasted and lined with a NSF approved fusion bonded epoxy UltraLiner™, applied by the fluidized bed method.

2. Meter tubes shall have a constant nominal inside diameter offering no obstruction to the flow. Electrodes shall be 316 stainless steel.

E. Mag Shield:

1. Shall be welded to the tube providing a completely sealed environment for all coils, electrode connections and wiring harness capable of NEMA 6P/IP68 operation.

F. Signal Converter:

1. Shall be pulsed DC coil excitation type with auto zeroing. The converter shall indicate direction of flow and provide a flow rate indication and a totalization of flow volume for both forward and reverse directions. Both forward and reverse totalizers shall be electronically resettable.
2. The flow meter converter shall be microprocessor based with a keypad for instrument set up and LCD displays for totalized flow, flow rate engineering units and velocity.
3. The converter shall power the flow sensing element and provide galvanically isolated dual 4-20mA outputs. 4-20 mA outputs shall be capable of system integration with a central terminal unit or a PLC. It shall be possible, in the test mode, to easily set the converter outputs to any desired value within the range. The 4-20mA scaling, time constants, pipe size, flow proportional output, engineering units and test mode values shall be easily set via the keypad and display.
4. Four separate fully programmable alarm outputs shall be provided to indicate empty pipe, forward/reverse polarity (normally open/close), analog over-range, fault conditions, high/low flow rates, percent of range and pulse cutoff.
5. The converter shall periodically perform self-diagnostics and display and resulting error messages. All set up and data and totalizer values may be protected by a password.
6. The converter shall be integral to the flange mounted sensor and shall be supplied in a sealed IP67 rated enclosure. Calibration will be completed at the manufacturer's location in accordance with customer supplied application-based requirements.

G. Grounding Rings:

1. 316 stainless steel grounding rings shall be supplied with the meter tube. Exception: On sensor models which use grounding electrodes, grounding rings are optional. For best performance, grounding rings are recommended for all sizes.

H. Power And Signal Isolation:

1. The power supplied between the converter and the meter tube (sensor) and signal between the meter tube and the converter shall be isolated and placed in separate submersible cables.

I. Service & Support:

1. Supplier must have flow calibration laboratories and personnel to perform testing and certify calibration. Personnel must also provide instruction or training as required assuring meters are supported and maintained throughout the guarantee period.

J. Volumetric Testing:

1. All meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated. The test facility must be rigorously traceable to an accuracy of $\pm 0.15\%$ with the National Institute of Standards and Technology. If desired, the test shall be witnessed by the customer or their selected agent. A copy of the certified accuracy test record must be furnished at no charge to the Owner.

2.06 RADAR LEVEL TRANSMITTERS

- A. This section describes the requirements for a 2-wire Radar level measuring system. Under this item, the contractor shall furnish and install the level measuring system, and all associated equipment and accessories as indicated on the plans and as herein specified. Radar level transmitters shall be provided for the following locations:
1. Existing clear well
 2. Sedimentation tank (installed in a stilling tube – see sedimentation tank details)
- B. Each radar level transmitter shall be mountable onto a pre-fab 4" flange on the tank surface or stilling tube.
- C. The microprocessor based high performance loop powered 2-wire Radar level transmitter shall employ microwave pulse ranging technology operating on 6.3 GHz to determine the distance to the monitored surface(s), as a basis for display, output, and digital communication. The unit should be configurable using remote and local interface.
- D. The level system shall consist of a transmitter/receiver, a rod antenna and a signal processor for continuous measurement of material levels of liquids and slurries in open or closed tanks or in stilling wells or in standpipes, without contacting the medium.
- E. The radar level transmitter shall:
1. Measure level, distance, space, and volume of the medium in the vessel
 2. Apply 11-point linearization to ensure accurate measurement in non-standard vessels.
 3. Be 2-wire loop powered.
 4. Create a digitized echo profile and apply patented Sonic Intelligence echo- processing techniques to select and verify the echo representing the reflective surface monitored.
 5. Process signal using advanced echo-processing techniques such as Auto False- Echo Suppression, and Agitator discrimination for maximum verification of the measurement, display and outputs.
 6. Be NEMA 4x and FM approved for Class I Division 1 areas Groups A,B,C,D with Intrinsically Safe Barrier.
 7. Have a Polyethylene Terephthalate enclosure with a Polyether Imide lid.

8. Have a single material for rod antenna and integrated threaded connection
 9. Compact electronics mounted in a rotating head.
 10. Provide user interface via local multi-graphic display with bar graph for readout & entry, and via analog current output.
 11. Communicate digitally by HART as a built-in standard.
 12. Be commissioned without opening the lid, using intrinsically safe Infrared hand held programmer locally, or remotely using HART hand held unit or Simatic PDM software package.
- F. Product Specification
1. Service: As noted
 2. Fluid: As noted, turbulent surface
 3. Operating Pressure: 0 to 150 PSI
 4. Process Temperature: minus 40 to 80°C (minus 4°F to 176°F)
 5. Humidity: 10 to 90%
 6. Installation Drawing: As noted
 7. Application: Level and volume monitoring in Closed tanks / Open Wet wells
- G. Performance
1. Range: 0.3 to 20 m (1.3 to 65')
 2. Accuracy: +/- 10 mm or +/- 0.1% of the range, whichever is greater
 3. Repeatability: +/- 5 mm
 4. Fail-safe: mA and "reading" programmable high, low or hold, or user selectable upon Loss of Echo (LOE) condition
- H. Sensor
1. Measuring Principle: Pulse-based microwave
 2. Frequency: 6.3 GHz
- I. Warranty
1. In the event of component failure during the warranty period, the manufacturer shall promptly replace the unit at no cost to the Owner.
- J. Acceptable Manufacturers
1. The manufacturer shall be an ISO 9000 rated facility. The unit shall be as manufactured by the following:
 - a. Vega VegaPuls
 - b. Endress & Hauser FMR10
 - c. Siemens Sitrans Probe LR200
 - d. Or equal.
- K. Installation
1. Each piece of equipment shall be rated for the location where it will be mounted.
 2. The unit shall be installed according to the manufacturer's recommendations.
 3. Mount the sensor to ensure a clear path to the surface is being measured.
 4. Provide stainless steel or FRP mounting brackets as required.

2.07 CHLORINE ANALYZER

- A. Section includes:
1. Online chlorine analyzer for continuous monitoring of free or total residual chlorine in water.
- B. Measurement Procedures
1. The method of measuring free or total chlorine will be colorimetric. Instrument chemistry will employ N, N-diethyl-p-phenylenediamine (DPD) method.
- C. Alternates
1. Other methods of chlorine measurement such as amperometric, potentiometric, and iodometric that employ electrodes or other electrochemical techniques are not acceptable.
- D. System Description
- a. Performance Requirements
 - b. Measurement range:
 - 0 to 10 mg/L (ppm) free or total residual chlorine
 - c. Accuracy
 - $\pm 5\%$ of reading or ± 0.04 mg/L (ppm), whichever is greater from 0 to 5 mg/L as Cl₂; $\pm 10\%$ from 5 to 10 mg/L as Cl₂
 - d. Precision
 - 5% of reading or 0.01 mg/L (ppm), whichever is greater
 - e. Lower Limit of Detection (LOD)
 - 0.03 mg/L (ppm)
 - f. Resolution
 - 0.01 mg/L (ppm)
 - g. Repeatability
 - 5% of reading or 0.01 mg/L (ppm), whichever is greater
 - h. Cycle Time
 - 2.5 minutes
- E. Certifications
1. Complies with US EPA 40 CFR 141.74
 2. CE compliant for conducted and radiated emissions CISPR 11 (Class A limits), EMC Immunity EN 61326-1 (Industrial limits), and EN 50581
 3. North America: FCC Supplier's Declaration of Conformance, IEC/EN 60529, ICES-003
- D. ACMA RCM
- South Korea KC Certificate
- F. Environmental Requirements
1. Operational Criteria
 - a. Sample flow rate
 - 60 to 200 mL/minute through the analyzer
 - b. Sample Filtration

- Y-strainer with 40-mesh screen or higher
 - c. Inlet Pressure
 - 4.5 to 75 psig (0.3 to 5.2 bar) supplied to Y-strainer; 1.5 to 5 psig (0.1 to 0.3 bar) supplied to analyzer
 - d. Sample temperature
 - 41 to 104 °F (5 to 40 °C)
 - e. Operating temperature
 - 41 to 104 °F (5 to 40 °C)
 - f. Operating humidity
 - 0 to 90% non-condensing relative humidity
- G. Warranty
 - 1. The product includes a one-year warranty from the date of shipment (EU: 2 years)
- H. Maintenance Service
 - 1. Scheduled Maintenance
 - a. Monthly
 - Reagent replacement
 - Cell cleaning
 - b. Semi-annually
 - Analyzer tubing replacement
- I. Manufacturer
 - 1. Hach Company, Loveland, CO: Model CL17sc Online Chlorine Analyzer
 - 2. Approved Equal
- J. Manufactured Unit
 - 1. The CL17sc Online Chlorine Analyzer consists of a sample and reagent pump, measurement cell, and if chosen can be shipped with buffer and indicator solutions.
- K. Equipment
 - 1. Online Chlorine Analyzer
 - Housed in an IP66-rated enclosure.
 - Capable of measuring free or total residual chlorine by changing the tubing and indicator and buffer solutions.
 - Measurements are taken every 2.5 minutes and results are displayed on a controller display or web-enabled display in the range of 0 to 10 mg/L.
 - Utilizes a built-in flow meter.
 - Real-time flow rate is measured when sample is flowing through the analyzer and results are displayed on a controller display or web-enabled display in mL / min.
 - Connects to a standard controller, which controls and provides power to the analyzer.
 - Performs a blank reference measurement check between analysis points to

compensate for sample color, turbidity, and changes in light intensity due to voltage fluctuations or light source aging.

- Operates with an LED light source at a peak wavelength of 510nm.
- Capable of operating unattended for 30 days between chemical reagent changes and measurement cell cleaning.
- Utilizes a three-color status light to indicate operating status.
- Utilizes three measurement cycle indicator lights to display the phase of the measurement cycle being performed.
- Has a colorimeter measurement cell window for viewing sample inside cell.
- Provides step-by-step, on-screen instructions for all routine maintenance activities, including reagent changes, tubing changes, and cell cleanings.
- When connected to a cloud-based standard controller is capable of providing remote monitoring of measurement and instrument data on a web-enabled device.

L. Standard Controller

1. Provide an SC controller for online chlorine analyzer operation.
2. Options for communication outputs determined by controller selection.

M. Components

1. Standard Equipment

- SC200 Controller
- CL17sc Online Chlorine Analyzer
- Installation kit
- Tubing kit
- User manual

2. Dimensions: 12.9 x 13.5 x 7.0 inches (329 x 342 x 177 mm)

3. Shipping weight: 9 lbs (4.1 kg)

2.06 TURBIDITY ANALYZER

A. Section includes

1. Turbidimeter for monitoring sample low-range (0.001 to 100 NTU) turbidity.

B. Measurement Procedures

1. The method of measuring turbidity will nephelometric.
 - a. Incandescent light will be directed into the sample stream in the turbidimeter body.
 - b. The light scattered at 90 degrees will be sensed by a submerged photocell in the measuring chamber.
2. The method will meet or exceed instrument design criteria set by USEPA method 180.1 and Standard Methods 2130B

C. Alternates

1. Other methods of turbidity measurement, such as those that require a sample cell with glass window that can foul or fog or require air purge, desiccant, or cleaning, are not acceptable.

D. System Description

1. Performance Requirements
 - a. Measurement range: 0.001 to 100 Nephelometric Turbidity Units (NTU).
 - b. Accuracy
 - 1) ± 2 percent of reading or ± 0.020 NTU (whichever is greater) from 0 to 10 NTU
 - 2) ± 5 percent of reading from 10 to 40 NTU
 - 3) ± 10 percent of reading from 40 to 100 NTU
 - c. Minimum detection limit: 0.001 NTU
 - d. Resolution
 - 1) 0.0001 NTU up to 9.9999 NTU
 - 2) 0.001 NTU from 10.000 to 99.999 NTU
 - e. Repeatability: $\pm 1.0\%$ of reading or ± 0.002 NTU, whichever is greater

E. Certifications

1. Not applicable

F. Environmental Requirements

1. Operational Criteria
 - a. Sample flow rate: 200 to 650 mL/minute
 - b. Sample temperature: 0 to 50 degrees C
 - c. Operating temperature: 0 to 40 degrees C
 - d. Operating humidity: 5 to 95 percent non-condensing

G. Warranty

1. The product includes a one-year warranty from the date of shipment.

H. Maintenance Service

1. Scheduled maintenance:
 - a. Calibration: as experience dictates.
 - 1) Use an optical based calibration/verification module.
 - 2) OR, use formazin-based standards.
2. Unscheduled maintenance
 - a. Clean photocell window
 - b. Clean instrument enclosure
 - c. Clean bubble trap
 - d. Lamp replacement

I. Manufacturer

1. Hach Company, Loveland, CO
 - a. Model 1720E Turbidimeter

J. Manufactured Unit

1. The 1720E Turbidimeter consists of an incandescent light source, photocell, and bubble trap.
2. The 1720E is housed in a NEMA 4X/IP66 enclosure made of corrosion-resistant polystyrene.
3. The optical components of the 1720E are mounted in a sealed, removable head assembly.

K. Equipment

1. The 1720E operates using 100 to 230 volt selectable AC power.
2. The 1720E operates continuously.
3. The sample stream into the 1720E flows through an internal bubble trap.

L. Components

1. Standard equipment:
 - a. Turbidimeter sensor head
 - b. Turbidimeter body
 - c. Manual
2. Dimensions:
 - a. Width: 12.3 inches
 - b. Height: 15.1 inches
 - c. Depth: 9.4 inches
3. Weight: 13.5 pounds
4. Connectors
 - a. Sample inlet fitting: 0.25-inch NPT female, 0.25-inch compression fitting
 - b. Drain fitting: 0.5-inch NPT female, 0.5-inch hose barb

M. Accessories

1. Calibration/verification module (Model ICE-PIC for 1720E)
2. StablCal® verification standards
3. Formazin calibration kit for user-prepared calibration
4. Floor stand

PART 3 – EXECUTION**3.01 INSTALLATION - GENERAL**

- A. Each instrument or system shall be installed, wired, calibrated, and tested in strict compliance with the manufacturer's instruction. Calibrate for operational range required for this project.
- B. Installation Hardware
 1. All nuts and bolts shall be stainless steel.
 2. Support channels mount externally, or mounted in a corrosive atmosphere, shall be stainless steel unistrut channels.
 3. Do not mount equipment directly to masonry or concrete walls. Provide unistrut channels on wall.
 4. All equipment mounting plates shall be of 0.25-inch thick minimum stainless steel.
 5. All contact surfaces between dissimilar metals shall be gasketed to prevent galvanic reaction.
- C. All test instruments used for field calibrations shall have a minimum accuracy of 3 times greater than that of the instrument being calibrated. Test instruments shall have been calibrated to National Bureau of Standards requirements within 6 months of their use on this project. Provide evidence of such calibration upon request by the Owner of Engineer.
- D. Final conduit connection to the instruments shall be through watertight flexible conduit. Where noted, final connection shall be by extra hard service cable rated for wet location. Use explosion-proof or liquid-tight flexible conduit where required.
- E. Line powered units shall receive 120 volt AC supply through a disconnect switch and surge protector.

3.02 ENVIRONMENTAL PROTECTION

- A. Transmitters and similar items located outdoors must be manufactured for the environment to be encountered.
- B. All transmitters and local control stations shall have aluminum sheet metal sun shields/weather shields.

3.03 FLOAT SWITCHES

- A. Do not cut cable slack. The float switch elevation shall be adjustable over the entire cable length (40 feet).
- B. When pipe mounting is indicated in the equipment data, provide a 1-inch aluminum mounting pipe, which shall be attached to the vessel wall by means of aluminum pipe brackets.

3.04 CALIBRATION

- A. In addition to the above requirements, calibrate each system as follows:
 - 1. Each system, including its complete instrument loop, shall be calibrated. Reading on the remote receiving instruments shall be equal to reading at the converter indicator.
 - 2. Provide a written loop-calibration report for each system and each instrument.

END OF SECTION

SECTION 25 30 10 – INSTRUMENT PANEL/PUMP CONTROL PANEL AND ENCLOSURE CONSTRUCTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The Contractor shall be responsible for procuring, installing, adjusting, and commissioning of the control panel necessary to place the control panel into service, including proper pump control and protective devices, adjustments and programming.
- B. Control Panels:
 - 1. Main SCADA Control Panel (MSCP)
 - 2. Remote HMI Control Panel
 - 3. Doghouse Control Panel
 - 4. Motor VFD Control Panel

1.02 QUALITY ASSURANCE

- A. Equipment specified herein shall meet applicable standards of the following agencies and associations:
 - 1. Underwriters' Laboratories, UL.
 - 2. National Electrical Manufacturers Association, NEMA.
 - 3. National Electrical Code (NEC)
 - a. Wire sizes inside the control panel shall comply with the NEC, for 60° C operation.

PART 2 – PRODUCTS

2.01 GENERAL

- A. The instrument panels and enclosures shall be as follows:
 - 1. Freestanding or rack mounted (Pump Control Panel or Instrument Panel) as indicated on the drawings and enclosure shall be rated NEMA 4X, stainless steel, provided with accessories and components as shown on the drawings and detailed in the project specifications.
- B. Provide conduit accessories as needed for conduits terminating at control panels, including watertight conduit hubs, conduit seals for explosion-proof wiring applications, and manufactured moisture seals for non-hazardous applications. Sealing putty is not acceptable.
- C. Provide ventilated wireway and pump termination/splice panels as indicated on the drawings.

2.02 PANEL CONSTRUCTION

- A. General
 - 1. Stiffening members shall be provided for strength and stiffness as required.
 - 2. Seamless welded construction shall be used throughout. All exposed seams shall be

continuously welded and ground smooth.

3. Lifting rings shall be provided.
4. Sub panels shall be provided as required, with mounting designed for easy removal. The subpanels shall be finished with 2 coats of white enamel paint.
5. Print pockets shall be attached to the interior side of each door.
6. Hinges shall be stainless steel piano continuous hinge type.
7. Provide 3-point door latching mechanisms with handles on front of panel door(s).
8. Provide gasketing if required for rating.

2.03 PANEL GROUNDING

- A. Provide an equipment grounding bus bar or terminal block.
 1. The ground busbars shall be of nickel-plated copper, rated for 100 amperes.
 2. The bus bar shall be provided with two (2) screw clamp terminal blocks, which shall be capable of accepting conductors up to #1 AWG.
 3. The bus bar shall be provided with a minimum of twenty (20) screw clamp terminal blocks, which shall be capable of accepting conductors up to #4 AWG.

2.04 PANEL WIRING

- A. Wiring within the enclosure shall be continuous and shall be terminated only at terminal blocks or equipment terminals.
- B. Not more than one wire shall be terminated at any terminal. Wiring splices and wire nuts will not be permitted within the enclosure.
- C. Wiring within the enclosure shall be protected as follows:
 1. In general, all wiring within the enclosure shall be routed in plastic wiring ducts. Wiring ducts shall be sized to include 100% (percent) spare capacity.
 2. Wiring outside of the ducts shall be restrained by means of plastic ties.
 3. Wiring passing a door hinge shall be grouped and wrapped in a protective wire harness.
 4. Provide abrasion protection for wire bundles passing through holes or across metal edges.
- D. In general, wiring within the enclosure shall be as follows:
 1. Control wiring within the enclosure shall be #14 AWG minimum, stranded, type MTW, 600V.
 2. Wiring for 4-20 mA DC analog signals shall be #18 AWG twisted shielded pair.
 - a. Cables shall meet the following criteria:
 - 1). U.L. Listed Subject 1277
 - 2). Pass IEEE 383 or UL 1581 Flame Test
 - 3). OSHA Acceptable
 - 4). Pass UL VW-1 Flame Test
 - 5). #18 AWG conductors, 7 strand, bare copper
 - 6). 100% aluminum/polyester foil shield
 - 7). 600-volt 90 degrees C rated insulation

- 8). Each conductor shall be numbered and color-coded.
 - 9). Comply with NEC articles #318, #340 and #501, for power limited tray cable (PLTC)
 - 10). Nominal 2" lay
 - 11). PVC insulation, with ripcord and nylon jacket
 - 12). Suitable for use in wet locations
 - b. The manufacturer of the cables shall be an ISO 9001 certified facility.
- E. In general, wiring within the enclosure shall follow the following color convention to comply with NFPA 79 (1994), part 16:
1. Neutral conductors shall be white.
 2. Line, load and control conductors shall be black.
 3. Grounding conductors shall be green.
 4. Foreign voltage control conductors shall be yellow or orange.
 5. Low voltage (below 50 volts) AC conductors shall be red.
 6. Low voltage neutral (grounded) conductors shall be white with a red stripe.
 7. DC control conductors shall be blue.
 8. DC (+) power conductors shall be blue with a white stripe or purple.
 9. DC (-) (grounded) power conductors shall be white with a blue stripe.
 10. Wiring with multi-conductor cables shall be color-coded.
- Note: Foreign voltage means all control circuits that may remain energized when the main disconnecting means is in the OFF position. Interlocking conductors shall be yellow or orange throughout the entire circuit, including wiring in the control panel and the external field wiring.
- F. AC and DC wiring shall be separated from each other. Where AC and DC wire runs parallel, the minimum separation between them shall be four (4) inches. Where AC and DC wire runs cross, they shall cross at 90 degrees C. Provide separate wiring duct for AC and DC wiring.
- G. Equipment and signal ground wiring, as well as Neutral wiring, shall not be daisy-chained; they shall each be terminated at isolated, bussed terminal blocks.
- H. Each conductor end shall be terminated at a terminal block or at an equipment-wiring terminal. Each terminal block shall have a unique identification number. The terminal blocks shall be arranged and numbered in consecutive order, based on standard alphanumeric order.
- I. Terminal blocks within enclosure shall be grouped as follows:
1. 480 Volts AC power.
 2. 120 Volts AC power.
 3. 120 Volts AC control wiring.
 4. AC isolated Neutral.
 5. 24 Volts DC power.
 6. 24 Volts DC control wiring for discrete signals
 7. 24 Volts DC Common.
 8. Analog signal wiring (for 4-20 mA DC signals).

9. Grounding.

- J. Provide 25% spare terminal blocks (minimum of six) for each type used in each enclosure.

2.05 TERMINAL BLOCKS

- A. Except for incoming power terminal blocks, terminal blocks within enclosures shall be of the high-density modular types, constructed of nylon material, suitable for mounting on standard DIN rails. Termination type shall be tubular screw with serrated pressure plate. The terminal block system shall be manufactured by Phoenix Contact, Weidmuller, or equal.
- B. All current carrying parts (metal bodies) shall be made of nickel/tin-plated copper.
- C. Ground terminals shall be color coded in accordance with international standard, which shall be yellow/green.
- D. Matching jumper bridges shall be color coded to the wiring colors.
- E. Panel power distribution fused terminal blocks shall be provided with disconnect lever puller mechanism and illuminated indication.
 - 1. Fused shall be standard $\frac{1}{4}$ " by $1\frac{1}{4}$ " and shall be sized as shown on the drawings.
 - 2. The terminal blocks shall be able to accept up to number 8 AWG conductor.
 - 3. Terminal blocks shall be rated for 15 amps at 250 VAC.
 - 4. Terminal blocks shall be Phoenix Contact type UK 6.3-HESiLA-250, Weidmuller type 6/2, or equal.
- F. Terminal blocks for discrete inputs and outputs shall be two-level types:
 - 1. Both levels shall be of the feed through types.
 - 2. Terminals shall be rated for up to 20 amperes at 300 VAC and shall be able to accept up to #12 stranded conductors.
 - 3. Terminal blocks shall be Phoenix Contact type UKKB-3, Weidmuller WDK 2.5, or equal.
- G. Terminal blocks for analog inputs and outputs shall be three-level types:
 - 1. The top and center terminations shall be feed through types.
 - 2. The bottom termination shall be grounded through the railing.
 - 3. The terminal blocks shall be rated for up to 10 amperes at 300 VAC and shall be able to accept up to #12 AWG stranded conductors.
 - 4. The terminal blocks shall be Phoenix Contact type SLKK-5, Weidmuller type DLD 2.5/PE or equal.
- H. Terminal blocks for foreign voltage "hot" conductors shall be single level disconnecting type:
 - 1. Blocks shall be orange or yellow to match control wiring per Part 2.04, F.
 - 2. The terminal blocks shall be rated for 10 amperes at 300 VAC and shall be able to accept #22 thru #12 AWG conductors.
 - 3. The terminal blocks shall be lever type with clear indication of open/close status.
 - 4. The terminal blocks shall be Weidmuller type WRT 2.5, Phoenix Contact or equal.

2.06 PANEL ACCESSORIES

- A. Provide (furnish and install) interposing relays to interface all field-mounted equipment with power limited electronic control and communication equipment. Use intrinsically safe relays where field devices are located in hazardous areas.
 - 1. Provide thermostatically controlled heater. Hoffman or approved equal
- B. Provide thermostatically controlled ventilation fan, louvers, filters, and screens, designed and manufactured for the application. Hoffman or approved equal.
- C. When VFDs are located inside the control panels, provide panel air conditioner; Hoffman or equal.

2.07 PANEL INSTRUMENTS

- A. Provide all analog signal boosters and isolators necessary to interface all field mounted equipment with control system equipment.
- B. Provide audible alarm signaling device. The device shall be as manufactured by Edwards, Federal Signal, Benjamin, or equal. The unit shall incorporate the following:
 - 1. Flush panel mounting.
 - 2. Weather and vandal resistant
 - 3. Internal gain control for output adjustment (80 dba maximum at 15 feet)
 - 4. UL listed
 - 5. Operating Voltage: 120 VAC

2.08 PILOT AND CONTROL DEVICES

- A. Pilot Devices: Pushbuttons, selector switches, and indicating lights shall be rated heavy-duty, oil-tight or watertight and corrosion resistant as required. All units shall be furnished with standard size legend plates with legends as described on the project Drawings.
- B. Selector switches shall have the number of positions, switching arrangement, number and type of contact blocks indicated on the project Drawings.
- C. Contact blocks shall have a minimum continuous current rating of 10 amperes at 240 VAC. Contact blocks shall have screw type connection terminals.
- D. Indicating lights shall be light emitting diode type 120VAC, color cap, and push-to-test feature. Provide flashing type lights where indicated.
- E. Pilot device manufacturers shall be: Allen-Bradley Bulletin 800H or 800T or equal by same manufacturer as motor starters.

- F. Control relays shall be plug-in type with sockets and hold-in clips. Sockets shall have screw terminals. Contacts shall be silver-cadmium, rated 10 amperes at 240 VAC. Relays shall have two-pole, double throw contacts (DPDT). Relays shall have a manual operator and pilot light. Coil voltages shall be 120 VAC, or as noted on the project Drawings. Relays shall be as manufactured by Allen-Bradley Bulletin 700, Type HA or HB, or equal by same manufacturer as motor starters.

2.09 EQUIPMENT IDENTIFICATION AND WIRE TAGGING

- A. All control wiring shall be identified by means of computer-generated, heat shrink type wire marker. Wire numbers shall be as shown on the drawings.
- B. Each component mounted within the enclosure shall be provided with equipment identification. Equipment and device nameplates or identification shall be of engraved laminated plastic, with white lettering on black background. Nameplates shall be as listed herein or as shown on the project Drawings.

2.10 REGULATED POWER SUPPLY

- A. When DC power supply is required for controllers, and 2-wire analog loops, provide two redundant 24 V DC regulated power supplies.
- B. The contractor shall be responsible for providing and sizing all instrument loop power supplies. The instrument loop power supplies shall be sized to include at least 100% spare capacity. Submit power supply load calculations with the panel shop drawings.
- C. Acceptable power supply manufacturers:
 - 1. Phoenix Contact
 - 2. SOLA
 - 3. Or equal

2.11 ACCESSORY CIRCUIT BREAKERS

- A. Accessory circuit breakers shall have terminal lug wire size #14 - #2 AWG Cu or Al. Reversible line and load lugs for flush mount wiring. DIN mounted (symmetrical rail 35 x 7.5 DIN/EN 50 022). UL Listed as HACR type from 15 A to 70 A. Field installable quick connectors. Single handle with internal common trip. UL Listed 120/240VAC (10,000 AIC).
- B. Accessory circuit breakers shall be thermal magnetic type. Accessory circuit breakers shall be supplied with reversible lugs. Mounting brackets shall be provided for flush installation.

2.12 MOTOR BRANCH CIRCUIT BREAKERS

- A. Motor branch-circuit breakers shall be thermal magnetic type circuit breakers with inverse time-current characteristics. Motor branch-circuit breakers shall be provided by manufacturer/supplier of solid-state motor controllers.

2.13 ACCESSORY AND CONTROL POWER TRANSFORMER

- A. Accessory and control power transformer primary shall be as specified on the drawings, dry type, rated 240/480-volt primary, 120 volt secondary, 60HZ, single phase, with two 5% FCBN taps, 115 degrees C temperature rise. Accessory and control power transformer shall be Acme or equal.

2.14 CONTACTORS AND MOTOR CONTROLLERS

- A. These units shall be type and size with the number of poles and accessories as indicated on the Drawings. Unless indicated otherwise, these units shall be by the same manufacturer as the motor starters. Refer to Specification 26 29 13 Motor Controllers.

2.15 ACCESSORY DEVICES

- A. These devices shall be heavy duty type and shall mount in the starter/pump control panel enclosure on the swing out panel or panel door, as indicated.
- B. Unless otherwise indicated, these devices shall be by the same manufacturer as the motor starters.

2.16 PUMP PANEL ENCLOSURE

- A. Provide stainless steel NEMA 4X enclosure, as indicated on the drawings, with interior painted steel back panel for mounting components, interior painted steel swingout panel for mounting control devices such as control switches and pilot lights, and exterior door with padlock hasp. Non-metallic panels, non-metallic swingout and non-metallic back panels are not acceptable.

2.17 SURGE PROTECTION DEVICE

- A. The SPD shall be constructed using multiple surge current diversion arrays of metal oxide varistors (MOV), matched to 1% variance. The array shall consist of multiple gap-less metal oxide varistors, with each MOV individually fused. The arrays shall be designed and constructed in a manner which ensures MOV surge current sharing. No gas tubes, silicon avalanche diodes or selenium plates/rectifiers shall be used. The status of each array shall be continuously monitored and a green LED shall be illuminated if the array is in full working order. All protection modes, including N-G, shall be monitored and internally fused. Summary alarm dry contacts shall be provided: phase loss, undervoltage, power loss, protection failure.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Provide and install all necessary bracket mounting devices, structural pieces and anchors necessary for this purpose.
- B. General mounting heights for the various type devices shall be as follows, unless otherwise indicated.
 - 1. Control Panel - 5'-6" to top.
- C. All control devices, motor starters, and relays inside the pump control panel shall be identified with engraved laminate nameplate.
- D. Pump control panel shall have engraved laminate nameplate on exterior.
- E. Install and connect pump cables furnished with each pump.
- F. Install and connect pump seal and temperature sensor cables for each pump motor.
- G. Furnish, install and connect control cables for each level float switch and install float switch.
- H. Furnish and install stainless steel strain relief mesh grips and anchors for each cable installed in the wet well as required.
- I. Furnish and install level sensor, cables, and stilling tube.

3.02 WIRING

- A. Provide wiring for all motors, starters and control equipment.
- B. Connections shown to equipment are approximate and do not represent the actual point of connection. Verify actual location before roughing-in.

3.03 START-UP AND COMMISSIONING

- A. The Contractor shall supply authorized personnel for start-up service as needed to ensure satisfactory operation. Subsequent trips to the job site to correct defects shall be made at no charge to the Owner during the warranty period. Demonstrate operation of the complete system and individual subsystems.
- B. Simulate failures/operations and detail how the operation/failure was simulated with the result. Include the final test results in the operation and maintenance manual.
- C. The above testing and commissioning may overlap with owner training.

3.04 TRAINING

- A. The system manufacturer shall supply authorized personnel to conduct a training session. The Owner shall have the right to video tape the training for future reuse.

- B. The training session(s) shall be conducted and repeated as needed until the Owner is satisfied that the operators are comfortable with the operation and maintenance of the system. Training shall be done on site with the owner's personnel. Start-up and training personnel shall provide their full attention to this customer while on site.
- C. Provide subsequent follow up with the Owner at 6 months and at 1 year to ensure any questions are addresses.

3.05 WARRANTY

- A. A 1-year warranty shall begin from the time of "substantial completion" as issued by the engineer. This shall cover parts and labor due to faulty components and/or workmanship, including software and programming.

END OF SECTION

SECTION 25 30 20 - PROCESS CONTROLLERS AND COMPUTER SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The work required under this section includes the provision, installation, start-up, testing and calibration of all computer, controller, software and networking required for this project.
- B. The types of systems required for this project include the following:
 - 1. AB CompactLogix 5370 Process Controller
 - 2. MapleSystems HMI
- C. The Systems Integrator shall be responsible for work of this division. Contractor for this project will have scope of work associated with Division 25; see Electrical drawings and Process drawings for associated information.
- D. Provide Owner with original licenses for all copies of all software, for all equipment and systems provided in Division 25. Provide the Owner with software version and printed documentation of all documented programs, as part of Record Documents and Operation and Maintenance Manuals. Provide the Owner with all passwords required for full program access for all levels of PLC, PC, HMI, LAN and VPN network programming. The Owner shall have full legal right to use without restriction, and modify if they choose at their own risk, all programs, screens and reports prepared for this project, for their use in operating, maintaining, and managing their facilities.

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the startup and commissioning of SCADA and similar systems of types and sizes to this project, whose products have been in satisfactory use in similar service, and whose products meet all requirements specified herein.
- B. Installer: Qualified with successful installation experience on projects with field instrument work similar to that required for this project.
 - 1. It is intended that an experienced electronic systems/instrumentation and control systems subcontractor shall be in responsible charge of all field instrument work.
- C. ISA Compliance: Comply with applicable Standards and Practices for Instrumentation published by the Instrument Society of America pertaining to field mounted instruments and related installations.
- D. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to

electrical systems, and provide products and components which have been UL-listed and labeled whenever such UL listed products are available.

- E. NEC Compliance: Comply with requirements as applicable to construction and installation of field mounted instruments and installations.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Section 25 13 00.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Ship instruments and accessories properly protected and packaged.
- B. Handle instruments and accessories carefully to prevent damage and protect from weather.

PART 2 PRODUCT

2.1 GENERAL

- A. For each system, provide a complete assembly with all required components, enclosures suitable for the environment and location, fittings, mounting brackets, and other components and accessories as needed to form a complete system.
- B. Provide conduit, raceway accessories, wiring and connections necessary to place the systems into service and necessary to interface the instruments to other equipment control panels, programmable controllers, SCADA system, and similar installations as required for the project.

2.2 NETWORKING

- A. Provide all necessary network setup and hardware to create a complete networked system between PLCs and SCADA computers.
- B. Minimum requirements:
 - 1. Provide in each specified PLC control panel an Ethernet switch with multiple ports to accommodate all equipment requiring Ethernet connection. The switch will be 10/100Mbps with auto-switching capabilities. Redlion or equal.
 - 2. A spare Ethernet port will be available for future connection and troubleshooting.
 - 3. Provide and setup a VPN connection to Main SCADA computer for Operator and Superintendent Connectivity over internet. Coordinate with town's IT personnel.

2.3 PROCESS CONTROLLERS

A. MANUFACTURERS

1. Allen-Bradley CompactLogix 5370 Series.
2. No Substitutes.

B. GENERAL

1. Perform stand-alone monitoring and control and include following as minimum.
 - a. Microprocessor based controller (PLC processor) to execute program instructions, store data, and control data transfer.
 - b. PLC memory.
 - c. I/O subsystem interfaces.
 - d. Power supply, including power conditioning and surge protection.
 - e. Communication interfaces.
 - f. Programming interface.
2. Must integrate with any existing network of PLCs, ASDs, LOIs and HMIs.
3. Utilized as Main SCADA PLC networked to local panel mounted PC and HMI software. See drawings for list of IO and connectivity to field instruments and devices.

C. PLC PROCESSORS - COMPACTLOGIX 1769-L24ER**D. PRODUCTS**

1. Features:
 - a. 10/100Mbps, RJ-45, Ethernet I/P Communication Interface Card mounted in one of the two available Communication Card Slots in processor chassis.
 - b. Ladder, sequential function chart (SFC), structured text, and function block programming ready.
2. Provide orderly shutdown on power failure, saving register contents with automatic restart on power restoration.
3. Interface to programmer unit for maintenance and troubleshooting. Continually update display when data requested. Provide capability to monitor or change following.
 - a. Discrete I/O.
 - b. Analog I/O.
 - c. Pulsed I/O.
 - d. Communication parameters.
 - e. Configuration data.
 - f. Internal program data values.

E. PLC POWER SUPPLY - P4

1. 85-264 VAC.
2. Sizing is the responsibility of System Supplier.

F. I/O MODULES

1. I/O modules specifically designed for interfacing of I/O signals to PLC processor. Screw-type removable wiring arms required for each I/O module are responsibility of System Supplier.
2. Include sufficient I/O modules to accommodate I/O with provisions for 20% spare I/O prewired to terminal strips. Where no I/O of a listed type (digital input, digital output, analog input, analog output) is shown, provide one spare prewired module. Each processor or I/O chassis must contain a minimum of one spare slot, beyond the required spare I/O. Provide 1769-N2 filler strips for all empty slots in processor and I/O chassis.
3. 120VAC Digital Input 1769-IA16
 - a. 120 VAC individually isolated as required by application.
 - b. 16 points per module.
 - c. LED indication of on/off status of each point.
4. 120 VAC Digital Output 1769-OA16
 - a. 120 VAC non-isolated as required by application.
 - b. 16 points per module.
 - c. LED indication of on/off status of each point.
 - d. Interposing relay for each output point required.
5. Analog Input 1769-IF4I
 - a. Individually isolated.
 - b. 6 points per module.
 - c. Accept 4-20 mAdc or 1-5 vdc inputs as required by application.
6. Analog Output 1769-OF4I
 - a. Individually isolated.
 - b. 6 points per module.
 - c. Transmit 4-20 mAdc.

G. ETHERNET ADAPTER 1769-ENBT

1. Provides connectivity between SCADA system and PLC processors on Ethernet data highway.
2. 10/100 auto-switching.

H. COMMUNICATIONS SOFTWARE

1. Communication software and configuration shall meet monitoring and control requirements of each process in accordance with functional descriptions.
2. Within each hardware unit communicating over data highway, include executive routines or traffic controller to control and coordinate activities on communication links. Use integrated, standard products for communication software to manage transmission protocols, line error detection, and message switching.
3. Interface software for transfer of data from one location to another.
4. Expandable systems shall accommodate addition of future equipment as specified elsewhere.
5. Diagnostic facilities to check performance of communication links and communications interface portion of devices on data highway.
6. Include routines to detect transmission errors. Perform automatic re-interrogations and retransmissions before alarm is sounded. Generate system alarms.

2.4 CELL MODEMS

- A. Provide a cell modem in the Main PLC control panel and the Doghouse control panel. The cell modem shall be configured for private security and only allow permissions for approved personnel to have access to the system.
- B. Coordinate with the Owner to obtain a SIM card for each cell modem from their service provider. Confirm correct operation and communications once the modems have been provisioned.
- C. Manufacturer:
 1. Sierra Wireless RV50X
 2. Or equal

END OF SECTION 25 30 20

(NO TEXT FOR THIS PAGE)

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUBMITTALS

- A. 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.
- B. Field Quality Control Test Reports.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 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.
 - 1. Exceptions:
 - a. Use variable-frequency drive cable for connection between variable-frequency motor controllers and associated motors.
- 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.

2.02 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. 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 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- H. 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.
- I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- J. 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.
 - 3. Color Code:
 - a. 240/120 V, 1 Phase, 3 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Neutral/Grounded: White.
 - b. Equipment Ground, All Systems: Green.
 - c. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid or stranded.
 - b. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN, THHN/THWN-2, or XHHW-2.

2.04 VARIABLE-FREQUENCY DRIVE CABLE

- A. Description: Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.
- B. Conductor Stranding: Stranded.
- C. Insulation Voltage Rating: 1000 V.
- D. Insulation: Use only thermoset insulation types; thermoplastic insulation types are not permitted.
- E. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.
- F. Provide metallic shielding.
- G. Jacket: PVC or Chlorinated Polyethylene (CPE).

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. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors, mechanical connectors, or compression connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use compression connectors.
- C. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

3. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 4. Conductors for Control Circuits: Use crimped terminals for all connections.
- 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. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 - G. Mechanical Connectors: Provide bolted type or set-screw type.
 - H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.06 ACCESSORIES

- A. Electrical Tape:
 1. 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 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 2. 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 degrees F and short-term 266 degrees F overload service.
 3. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 4. 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 degrees F.
- 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.
- C. Wire Pulling Lubricant:
 1. Listed and labeled as complying with UL 267.
 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed; approved by conductor/cable manufacturer.
 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.
- E. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Circuiting Requirements:
 1. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 2. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.

- b. Size raceways, boxes, etc. to accommodate conductors.
- 3. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. 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.
- E. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.
- F. Install conductors with a minimum of 12 inches of slack at each outlet.
- G. Make wiring connections using specified wiring connectors.
- H. 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.
- I. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- J. 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.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUBMITTALS

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

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

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 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 raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
 - 5. Ground Rod Electrode(s):
 - a. Provide two electrodes unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
- E. 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.
- F. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- 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 05 26:
1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- 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 or compression connectors for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
- D. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 5/8 inch diameter by 8 feet length, unless otherwise indicated.

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. 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 (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems.
 - 1. Fiberglass Channel/Strut Framing Systems: Include requirements for strength derating according to ambient temperature.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for 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 galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
 - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 2. Comply with MFMA-4.
 - 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 4. Minimum Channel Thickness: Steel sheet, 14 gauge, 0.0747 inch.
 - 5. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- E. Fiberglass Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, fiberglass channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 2. Channel Material: Use polyester resin or vinyl ester resin.
 3. Minimum Channel Dimensions: 1-5/8 inch wide by 1 inch high.
 4. Flammability: Fire retardant with NFPA 101, Class A flame spread index, maximum of 25, when tested in accordance with ASTM E84; self extinguishing in accordance with ASTM D635.
- F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - b. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - c. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - d. Outlet Boxes: 1/4-inch diameter.
 - e. Luminaires: 1/4-inch diameter.
- G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 2. Concrete: Use expansion anchors or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 7. Sheet Metal: Use sheet metal screws.
 8. Plastic and lead anchors are not permitted.
 9. Powder-actuated fasteners are not permitted.
 10. Hammer-driven anchors and fasteners are not permitted.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

END OF SECTION

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUBMITTALS

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

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or rigid PVC conduit.
 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), rigid PVC conduit, or high-density polyethylene (HDPE) conduit.
 3. Where rigid polyvinyl chloride (PVC) conduit or high-density polyethylene (HDPE) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or schedule 80 rigid PVC conduit where emerging from underground.
 4. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 5. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).
- F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), aluminum rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).
- G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).
- H. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC).
- I. Corrosive Locations Above Ground: Use aluminum rigid metal conduit (RMC) or reinforced thermosetting resin conduit (RTRC).

1. Corrosive locations include, but are not limited to:
 - a. Chemical storage areas.
- J. Flexible Connections to Vibrating Equipment:
 1. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 2. Maximum Length: 6 feet unless otherwise indicated.
 3. Vibrating equipment includes, but is not limited to:
 - a. Motors.

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuits: 3/4-inch trade size.
 2. Branch Circuit Homeruns: 3/4-inch trade size.
 3. Underground, Interior: 3/4-inch trade size.
 4. Underground, Exterior: 1-inch trade size.
- E. 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. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- B. Fittings:
 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
 2. Material: Use aluminum.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. 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.
 - a. Do not use die cast zinc fittings.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. 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.
 - a. Do not use die cast zinc fittings.
 - 3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 - 4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.
 - 5. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. 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 degrees C.
- B. 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.

2.09 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: As recommended by manufacturer.
- C. Fittings: Same type and manufacturer as conduit to be connected.

2.10 HIGH-DENSITY POLYETHYLENE (HDPE) CONDUIT

- A. Description: NFPA 70, Type HDPE high-density polyethylene solid-wall conduit complying with ASTM F2160 and NEMA TC 7; list and label as complying with UL 651A; Schedule 40 unless otherwise indicated.
- B. Mechanical Fittings: Comply with ASTM F2176; list and label as complying with UL 651A.

2.11 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- D. Foam Conduit Sealant:

1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Aluminum Rigid Metal Conduit (RMC): Install in accordance with NECA 102.
- E. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.
- F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- G. Conduit Routing:
 1. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 2. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across building exterior surfaces.
 3. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 4. Route conduits above water and drain piping where possible.
 5. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
- H. Conduit Support:
 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 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 conduit clamp to support single conduit from beam clamp or threaded rod.
 6. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 7. Use of spring steel conduit clips for support of conduits is not permitted.
 8. Use of wire for support of conduits is not permitted.
- I. 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. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 5. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.

6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
- J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 3. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 4. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 5. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- K. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
- L. 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 polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 4. Where conduits are subject to earth movement by settlement or frost.
- M. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. Where conduits may transport moisture to contact live parts.
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- N. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

END OF SECTION

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures and underground boxes/enclosures.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

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. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
 5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 6. Use suitable concrete type boxes where flush-mounted in concrete.
 7. Use suitable masonry type boxes where flush-mounted in masonry walls.
 8. Use raised covers suitable for the type of wall construction and device configuration where required.
 9. Use shallow boxes where required by the type of wall construction.
 10. Do not use "through-wall" boxes designed for access from both sides of wall.
 11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
 14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
- 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. Junction and Pull Boxes Larger Than 100 cubic inches:

- a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
- D. Underground Boxes/Enclosures:
 - 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 - 2. Size: As indicated on drawings.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 - 4. Provide logo on cover to indicate type of service.
 - 5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
 - b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 - 6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.

PART 3 EXECUTION

3.01 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. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- E. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 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.
- F. Install boxes as required to preserve insulation integrity.
- G. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 6 inches deep.
 - 2. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 - 3. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
 - 4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- I. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

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. Panelboards:
 - 1) Identify power source and circuit number. Include location when not within sight of equipment.
 - 2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Enclosed switches, circuit breakers, and motor controllers:
 - c. Transfer Switches:
 - 1) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 3. 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. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 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.
- C. Identification for Boxes:
1. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 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.
- 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.

2.03 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.

2.04 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 1. Materials:
 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. 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.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1.02 QUALITY ASSURANCE

- A. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for purpose intended.
- B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

2.02 OUTDOOR PHOTO CONTROLS

- A. Stem-Mounted Outdoor Photo Controls:
 - 1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
 - 2. Housing: Weatherproof, impact resistant polycarbonate.
 - 3. Photo Sensor: Cadmium sulfide.
 - 4. Provide external sliding shield for field adjustment of light level activation.
 - 5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
 - 6. Voltage: As required to control load indicated on drawings.
 - 7. Load Rating: As required to control load indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 05 33.16.
- C. Maintain separation of remote-control, signaling, and power-limited circuits.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Where required and not furnished with lighting control device, provide wall plate; see Section 26 27 26.
- G. Provide required supports; see Section 26 05 29.
- H. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.

- I. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.

END OF SECTION

SECTION 26 24 16 PANELBOARDS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating as indicated on the drawings.
 - 2. Listed series ratings are not acceptable.
- C. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- D. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 2. Fronts:
 - 3. Lockable Doors: All locks keyed alike unless otherwise indicated.
- G. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.02 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Aluminum.
 - 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Fusible Switches:
 1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
 2. Fuse Clips: As required to accept indicated fuses.
 3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- B. Molded Case Circuit Breakers:
 1. 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.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 5. Do not use tandem circuit breakers.
 6. Do not use handle ties in lieu of multi-pole circuit breakers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- G. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.
- J. Provide filler plates to cover unused spaces in panelboards.

END OF SECTION

**SECTION 26 28 13
FUSES**

PART 2 PRODUCTS

1.01 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Class J Fuses: Comply with UL 248-8.
- I. Class CC Fuses: Comply with UL 248-4.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 28 16.16 ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 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 on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Horsepower Rating: Suitable for connected load.
- D. Voltage Rating: Suitable for circuit voltage.
- E. 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 as indicated on the drawings.
 - 2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 200,000 rms symmetrical amperes.
- F. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- J. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- K. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 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 05 29.
- E. 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.
- F. Provide grounding and bonding in accordance with Section 26 05 26.
- G. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

END OF SECTION

SECTION 26 29 23 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable-frequency motor controllers (VFD or VSD).

1.2 RELATED WORK

- A. Related work includes pump and motor control panel fabrication and instrumentation and control by other Divisions. For this project, VFDs will be furnished and installed as part of custom motor control panels, provided by the Division 25 Contractor and by Pump/Equipment suppliers. The Division 26 Contractor is encouraged to communicate scope of supply and scope of installation regarding VFDs and related work with the General Contractor. In general, the Division 26 Contractor shall be responsible for installing and wiring VFD Control Panels furnished by others and installing and wiring related instruments furnished by others.

1.3 REFERENCES

- A. NEMA ICS 3.1 – Safety Standards for construction and guide for selection, Installation and Operation of Variable Speed Drive Systems.
- B. NEMA – Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. UL, and CUL Approved
- D. IEEE Standard 444 (ANSI C343)
- E. IEC: 146A

1.4 SUBMITTALS

- A. Shop drawings shall include wiring diagrams, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends, and enclosure details.
- B. Product Data: Provide data sheets showing voltage, ratings and size of switching and overcurrent protective devices, short circuit ratings, and weights.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of adjustable speed drives.

1.5 QUALITY ASSURANCE

- A. VFD shall have a minimum MTBF (mean time between failure) rating of 28 years.

1.6 OPERATION AND MAINTENANCE DATA

- A. Include instructions for starting and operating VFD and describe operating limits that may result in hazardous or unsafe conditions.

1.7 QUALIFICATIONS

- A. Manufacturer regularly engaged in designing, manufacturing and servicing variable speed drives, with a minimum of five years experience, NEMA and ISO certified.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver store, protect and handle products to site, under provisions of applicable Division 01 Sections.
- B. Accept VFD on site in original packing. Inspect for damage.
- C. 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.
- D. Handle carefully, in accordance with manufacturer's written instructions to avoid damage to components, enclosure, and finish.

1.9 WARRANTY

- A. Provide VFD warranty, for one year from date of startup. Warranty shall include parts, and labor allowance for repair hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Allen Bradley PowerFlex 755. ABB ACQ580, Square-D ATV630 or approved equal.

2.2 DESCRIPTION

- A. Provide enclosed adjustable speed drives suitable for operating at the current, voltage, and horsepower indicated on the schedule. Conform to requirements of NEMA ICS 3.1.

2.3 RATINGS

- A. The VFD shall be rated to operate from 3-phase power at one of the following voltage ranges. (380-480), VAC +10%/-15%, 48Hz to 63Hz. 5-400 hp the VFD shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 1.0. at all speeds and nominal load. The input power factor shall have programming capability to adjust power factor lagging to leading. The ULH standard VFD efficiency shall be 96.5% or better at full speed and load.
- B. The overvoltage trip level shall be a minimum of 30% over nominal, and the under-voltage trip level shall be a minimum 35% under the nominal voltage.
- C. Normal Duty / Variable Torque output voltage and current ratings shall match the adjustable frequency operating requirements of a standard AC induction, synchronous reluctance (SynRM) or permanent magnet (PM) motors in water and wastewater applications. The short-term normal duty overload current capacity shall be 110% of rated current for one (1) minute out of ten (10) minutes. (See paragraph M below.)
- D. Heavy Duty / Constant Torque output voltage and current ratings shall match the adjustable frequency operating requirements a standard AC induction, synchronous reluctance (SynRM) or permanent magnet (PM) motors in water and wastewater applications. The short-term heavy-duty overload current capacity shall be 150% of rated current for one (1) minute out of ten (10) minutes and peak overload capacity shall be 180% for two (2) seconds out of each minute with an instantaneous overcurrent trip at 350% or higher. Output frequency shall be adjustable between 0Hz and 500Hz forward or reversing. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.
- E. The VFD shall be furnished in an Open Chassis (IP00), UL Type 1 (NEMA 1) or UL Type 12* (NEMA 12*) listed enclosure rated as specified for operation at ambient temperatures between -15°C and 40°C at an altitude not exceeding 3300 feet, with relative humidity less than 95% and no condensation allowed.
- F. The printed circuit boards (PCB) shall be conformal coated to protect from atmospheric contamination by Chemical gasses and Solid particles per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.
- G. VFD must operate without fault or failure, when voltage varies plus or minus 10 percent from rating, and frequency varies plus or minus 5 percent from rating.
- H. Displacement Power Factor: 0.98 over entire range of operating speed and load.
- I. Humidity: non-condensing to 95%.
- J. Altitude: to 3300 feet, higher altitudes achieved by derating.
- K. Starting Torque: 100% starting torque shall be available from 0.5 Hz. to 60 Hz.

- L. Overload capability: 120% of rated F.L.A. (full load amps) for 60 seconds; 180% of rated F.L.A., instantaneously.
- M. The VFD continuous ampere rating shall be 115% of the motor full load amperes; to match the service factor rating of the motor.

2.4 DESIGN

- A. VFD shall employ microprocessor based inverter logic, isolated from all power circuits.
- B. VFD shall include surface mount technology, with conformal coating.
- C. VFD shall employ a PWM (pulse width modulated) inverter system, consisting of:
 - 1. Input Section:
 - a. VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid-state full wave diode rectifier, with MOV (metal oxide varistor) protection.
 - 2. Intermediate Section:
 - a. DC bus as a supply to the VFD Output Section shall maintain a fixed voltage with filtering and short circuit protection.
 - b. DC Bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.
 - c. 30hp – 250hp VFDs shall include a DC bus reactor to help minimize reflected harmonics.
 - 3. Output Section
 - a. Insulated gate bipolar transistors (IGBT's) shall convert DC bus voltage to variable frequency and voltage.
 - b. PWM sine coded output to the motor.
- D. The VFD must be selected for operation at carrier frequencies at or above 5KHz without derating to satisfy the conditions for current, voltage, and horsepower as indicated on the equipment schedule. Exception to this requirement is allowed only for VFDs providing 80 amps or more.
- E. VFD shall have an adjustable carrier frequency. The carrier frequency shall have a minimum of six settings to allow adjustment in the field.
- F. VFD shall include two independent remote reference input. One shall be 0-10 VDC. The other shall be programmable for either 0-10 VDC or 4-20 mA. Either input shall respond to a programmable bias and gain.

- G. VFD shall include a minimum of five multi-function-input terminals, capable of being programmed to determine their function when their state is changed. These terminals shall provide up to 30 functions, including, but not limited to:
 - 1. Remote/Local operation selection
 - 2. Detection of external fault condition
 - 3. Remote Reset
 - 4. Multi-step speed commands
 - 5. Jog Command
- H. VFD shall include a 4-20maDC 24VDC analog output for "speed tracking" the VFD. The 4-20maDC, 24VDC analog output signal will be proportional to output frequency, output current, output power, or DC bus voltage.
- I. VFD shall provide terminals for remote contacts, to allow starting in the automatic mode.
- J. VFD shall include at least one external fault input, which shall be programmable for normally open or normally closed contact.
- K. VFD shall include fully rated form "A" contacts and fully rated from "C" contacts, capable of being programmed to determine what conditions must be met in order for them to change their state. These contacts shall be rated for at least 1A at 250 VAC. Refer to the drawings for intended connections to the Plant Instrumentation and Control System.
- L. VFD shall include a power loss ride through of 2 seconds.
- M. VFD shall include a front mounted, sealed keypad operator, with an English language illuminated LCD display. The operator will provide complete programming, operating, monitoring, and diagnostic capability. Keys provided shall include commands for RUN, STOP, and RESET. Operating mode (auto or manual) and speed setting functions shall be provided.
- N. VFD English display provide readouts of; output frequency in hertz, output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, interface terminals status, and fault codes. All displays shall be viewed in an easy -to-read illuminated LCD with English language as standard.
- O. VFD unit shall include the following meters to estimate use of energy:
 - 1. Elapsed Time Meter
 - 2. Kilowatt Meter
 - 3. Kilowatt Hour Meter
- P. VFD shall be capable of PID (Proportional, Integral, and Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference. In addition, energy saving sleep function should be used in conjunction with the PID control.

- Q. VFD shall include loss of input signal protection, with a speed default to 80% of the most recent speed.
- R. VFD shall include electronic thermal overload protection for both the drive and motor. Protection profiles shall be available for variable and constant torque applications.
- S. VFD shall include the following program functions:
 - 1. Critical frequency rejection capability: 2 selectable, adjustable dead-bands.
 - 2. Auto restart capability: 0 to 10 attempts.
 - 3. Stall prevention capability.
 - 4. "S" curve soft start capability.
 - 5. "Speed search" capability, in order to start a rotating load.
 - 6. 1 preset and 1 custom volts per hertz pattern.
 - 7. One fully adjustable volts per hertz pattern.
 - 8. Current limit adjustment capability, from 30% to 200% of rated full load current of the VFD.
 - 9. Anti "wind-milling" function capability.
 - 10. Energy saving PID control with SLEEP function.
 - 11. Undertorque/Overtorque Detection.
 - 12. Ability to close fault contact after the completion of all fault restart attempts.
- T. VFD shall include factory settings for all parameters, and the capability for those settings to be reset.
- U. VFD shall include the capability to adjust the following functions, while the VFD is running:
 - 1. Forward/Reverse direction.
 - 2. Acceleration adjustment from 0 to 3600 seconds.
 - 3. Deceleration adjustment from 0 to 3600 seconds.
 - 4. A minimum of six different preset speeds.
 - 5. Analog output gain, to calibrate the signal for the application used.
- V. VFD shall include NEMA rated by-pass contractor and controls when indicated on drawings.

2.5 PRODUCT ACCESSORIES

- A. VFD's not requiring Manual Bypass, a local-remote selector switch will be provided to conveniently switch between "manual" and "auto" modes.
- B. Serial communications gateway, for either RS-232 or RS-485, to provide interface from an VFD to a computer, a Program Logic Controller (PLC), Modbus RTU, or Building Automatic System.
- C. Remote operator station to control and monitor the VFD from remote location.
- D. VFD shall have 3% Line Reactor and 3% Load Reactor.

2.6 FABRICATION

- A. Enclosure: Open type, for installation within a fabricated control panel.
- B. Enclosure shall have ventilation filter, ventilation fan, louvers, and automatic ventilation controls.
- C. Inspect and test, under load, each completed VFD assembly prior to shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for VFD installation.
- B. Do not install VFD until the building environment can be maintained, within the service conditions required by the manufacturer.

3.2 INSTALLATION

- A. Install VFD where indicated, in accordance with manufacture's written instruction and NEMA ICS 3.
- B. Tighten accessible connections and mechanical fasteners after placing VFD.
- C. Provide neatly typed label; on each VFD, identifying nameplate horsepower, full load amperes, model number, service factor and voltage/phrase rating.

3.3 FIELD QUALITY CONTROL

- A. Protect from physical damage, and provide proper alignment, anchorage, and grounding.

3.4 ADJUSTING

- A. Adjust work and calibrate system, to assure proper operation of driven equipment.

END OF SECTION 26 29 23

(NO TEXT FOR THIS PAGE)

**SECTION 26 43 00
SURGE PROTECTIVE DEVICES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
 - 1. Single Split Phase Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. 240/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1. Indoor clean, dry locations: Type 1.
- H. Mounting for Field-installed, Externally Mounted SPDs: As indicated on the drawings.

2.02 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Surge Protective Device:
 - 1. Protection Circuits: Field-replaceable modular or non-modular.
 - 2. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
 - 3. UL 1449 Nominal Discharge Current (I-n): 20 kA.
 - 4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
 - 5. Diagnostics:
 - a. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
 - b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 - 6. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- C. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

END OF SECTION

**SECTION 26 51 00
INTERIOR LIGHTING**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Battery:
 - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Bond products and metal accessories to branch circuit equipment grounding conductor.
- G. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- H. Install lamps in each luminaire.

END OF SECTION

**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Exterior LED wall packs shall have an adjustable setting. Default installation is at minimal output.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires in accordance with NECA/IESNA 501.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Install lamps in each luminaire.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic-ways if required by Owner or authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 23 23 - Fill.
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 50 00 – Temporary Facilities and Controls.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 EXISTING UTILITIES

- A. Locate, identify, and disconnect utilities indicated to be abandoned in place.

END OF SECTION 31 10 00

SECTION 31 23 16 – EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for performing open cut excavations to the widths and depths necessary for constructing structures, pipelines and conduits including excavation of any material necessary for any purpose pertinent to the construction of the Work.

1.2 RELATED DOCUMENTS

- A. The following drawings and general provisions apply to this Section.
 - 1. Section 31 10 00 "Site Clearing"
 - 2. Section 31 23 16.13 "Trenching"
 - 3. Section 31 23 23 "Fill"

1.3 DEFINITIONS

- A. Earth: "Earth" includes all materials which, in the opinion of the Engineer, do not require blasting, barring, or wedging for their removal from their original beds. Specifically excluded are all ledge and bedrock and boulders or pieces of masonry larger than one cubic yard in volume.
- B. Rock: "Rock" includes all materials which, in the opinion of the Engineer, require blasting, barring, or wedging for removal from their original beds and which have compressive strengths in their natural undisturbed state exceeding 300 psi. Boulders or masonry larger than one cubic yard in volume are classed as rock excavation.

1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Dewatering Excavation Plan: Develop an excavation dewatering plan that considers site ground and groundwater conditions, the type and arrangement of the equipment to be used and the proper method of groundwater disposal. Prepare the dewatering plan before beginning excavations below groundwater. Maintain one copy of the dewatering plan at the project site to be available for inspection while all dewatering operations are underway.

1.5 SITE CONDITIONS

- A. Existing Conditions: Make any geotechnical investigations deemed necessary to determine existing site conditions.
- B. Underground Utilities: Locate and identify all existing underground utilities prior to the commencement of Work.
- C. Quality and Quantity: Investigate and determine the quality, quantities, and methods to be used to excavate earth and rock.

PART 2 - EXECUTION

2.1 GENERAL

- A. Clearing: Clear open cut excavation sites of obstructions preparatory to excavation. Clearing in accordance with Section 31 10 00, includes removal and disposal of vegetation, trees, stumps, roots, and bushes, except those specified to be protected during trench excavation.
- B. Banks: Shore or slope banks to the angle of repose to prevent slides or cave-ins in accordance with Section 31 23 16.13 "Trenching".
- C. Hazardous Materials: If hazardous materials not specifically shown or noted are encountered, proceed in accordance with General Conditions Article 5.06, Hazardous Environmental Condition at Site.

2.2 TRENCH EXCAVATION

- A. Refer to Section 31 23 16.13 "Trenching" for trenching requirements.

2.3 FINISHED EXCAVATION

- A. Finish: Provide a reasonably smooth finished surface for all excavations, which is smooth and uniformly compacted.
- B. Finish Methods: Provide a degree of finish which is ordinarily obtainable from blade-grade operations, except as otherwise specified in Section 31 23 23 "Fill".

2.4 PROTECTION

- A. Traffic and Erosion: Protect newly graded areas from traffic and from erosion.
- B. Repair: Repair any settlement or washing away that may occur from any cause, prior to acceptance. Re-establish grades to the required elevations and slopes.

- C. Other Requirements: Conduct all Work in accordance with the environmental protection requirements specified in Division 01.

2.5 AUTHORIZED ADDITIONAL EXCAVATION

- A. Carry the excavation to such additional depth and width as authorized in writing, for the following reasons:
 - 1. In case the materials encountered at the elevations shown are not suitable.
 - 2. In case it is found desirable or necessary to go to an additional depth, or to an additional depth and width.
- B. Refill Materials: Refill such excavated space with either 3,000 psi lean concrete or compacted select fill material.
- C. Compaction: Where necessary, compact fill materials to avoid future settlement.
- D. Payment: Additional earth excavations so authorized, concrete or select fill materials authorized for filling such additional excavation, and compaction of select fill materials will be paid for as a change in the Work.

2.6 UNAUTHORIZED EXCAVATION

- A. Stability: Refill any excavation carried beyond or below the lines and grades shown, except as specified in the subsection headed "Authorized Additional Excavation", with such material and in such manner as may be approved to provide for the stability of the various structures.
- B. Refill Materials: Refill spaces beneath all manholes, structures, pipelines, or conduits excavated without authority with 3,000 psi lean concrete or compacted select fill material, as approved.
- C. Payment: Refill for unauthorized excavation will not be measured and no payment will be made therefor.

2.7 SEGREGATION STORAGE AND DISPOSAL OF MATERIAL

- A. Stockpiling Suitable Materials: Stockpile topsoil suitable for final grading and landscaping and excavated material suitable for backfilling or embankments separately on the site in approved locations.

- B. Stockpile Locations: Store excavated and other material a sufficient distance away from the edge of any excavation to prevent its falling or sliding back into the excavation and to prevent collapse of the wall of the excavation. Provide not less than 2 feet clear space between the top of any stockpile and other material and the edge of any excavation.
- C. Excess Materials: Transport and dispose of surplus excavated material and excavated material unsuitable for backfilling or embankments at an off-site disposal location. Obtain the off-site disposal location.

2.8 REMOVAL OF WATER

- A. Water Removal: During the excavation period and until completion and acceptance of the Work at final inspection, immediately remove and properly dispose of all water entering any excavation or other parts of the Work.
- B. Dry Excavations: Keep the excavation dry.
- C. Discharge of Water: Dispose of water pumped or drained from the Work in a safe and suitable manner without damage to adjacent property or streets or to other work under construction.
- D. Protection: Provide adequate protection for water discharged onto streets. Protect the street surface at the point of discharge.
- E. Sanitary Sewers: Do not discharge water into sanitary sewers. Do not discharge water containing settleable solids into storm sewers.
- F. Repair: Promptly repair all damage caused by dewatering the Work site.

END OF SECTION 31 23 16

SECTION 31 23 16.13 - TRENCHING

PART 1 - GENERAL

- A. Excavate subsoil required for utilities.
- B. Remove lumped subsoil, boulders, and rock.
- C. Perform excavation in accordance with utility's requirements.
- D. Do not advance open trench more than 100 feet ahead of installed pipe.
- E. Cut trenches sufficiently wide, within established construction limits and/or temporary construction easements, to enable installation and allow inspection. Remove water or materials that interfere with work.
- F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- G. Excavate trenches to depth indicated on drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- H. Do not interfere with 45 degree bearing slay of foundations.
- I. When project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by engineer until suitable material is encountered.
- J. Cut out soft areas of subgrade not capable of compaction in place. Backfill with subsoil fill and compact to density equal to or greater than requirements for subsequent backfill material.
- K. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by engineer.
- M. Remove excess subsoil not intended for reuse, from site.
- N. Provide means of ingress and egress from the trenches as required by applicable safety and health regulations.

(NO TEXT FOR THIS PAGE)

SECTION 31 23 19 – DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes construction dewatering.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.

- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 31 25 00 "Erosion and Sedimentation Controls", during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power, and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water levels before excavation below groundwater level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades, Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that lead to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill any well holes with bentonite grout or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

1. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 31 23 19

(NO TEXT FOR THIS PAGE)

SECTION 31 23 23 - FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Subsoil fill materials.
2. Coarse aggregate materials.
3. Fine aggregate materials.
4. Backfilling site structures to subgrade elevations.
5. Fill for over-excavation.

B. Related Sections:

1. Section 31 23 16.13 - Trenching.

1.2 REFERENCES

A. Indiana Department of Transportation (INDOT) Standard Specifications (latest edition).

B. ASTM International:

1. ASTM D698 - Standard Test Method for Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (shallow depth).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Materials Source: Submit name of imported fill materials suppliers.

C. Material Data: Submit gradation charts, sieve analysis for imported aggregate testing results.

D. Test Reports: Submit certified laboratory reports of all proposed backfill material. Test reports are to be dated within 6 months of backfill operation.

1.4 QUALITY ASSURANCE

- A. Furnish each imported material from single source throughout the Work.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Excavated and reused material; graded and free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Structural Fill: Coarse aggregate #8 aggregate conforming to INDOT Standard Specifications.
- C. Granular Fill: B-borrow sand conforming to INDOT Standard Specifications.
- D. Select Fill: No. 53 aggregate conforming to INDOT Standard Specifications.
- E. Concrete Fill: Concrete used for fill around utility piping shall have a compressive strength of 3,000 psi concrete.
- F. Frozen Materials: Do not use frozen material for filling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify subdrainage, damp proofing, or waterproofing installation has been inspected.
- B. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 STOCKPILING

- A. Stockpile materials on site at locations approved by Owner.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion and deterioration of materials.
- E. Stockpile Cleanup: Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

3.3 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with subsoil fill and compact to density equal to or greater than requirements for subsequent fill material.

3.4 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact in accordance with INDOT standards.
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Make gradual grade changes. Blend slope into level areas.
- G. Remove surplus backfill materials from site.
- H. Leave fill material stockpile areas free of excess fill materials.

3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.5 inch from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Perform laboratory material tests in accordance with ASTM D698.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
 - 2. Moisture Tests: ASTM D1557.

- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- E. Proof roll compacted fill surfaces under slabs-on-grade and paving.

3.7 PROTECTION OF FINISHED WORK

- A. Section 01 73 00 - Execution.
- B. Section 01 77 00 – Closeout Procedures.
- C. Reshape and re-compact fills subjected to vehicular traffic.

3.8 SCHEDULE

- A. Fill to Correct Over-excavation:
 - 1. Select fill, flush to required elevation, compact uniformly to 95 percent of maximum density.

3.9 COMPACTION EQUIPMENT

- A. Equipment and Methods: Carry out all compaction with suitable approved equipment and methods.
 - 1. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use handheld pneumatic tampers elsewhere for compaction of cohesive fill material.
 - 2. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.
 - 3. Do not use heavy compaction equipment over pipelines or other structures unless the depth of fill is sufficient to adequately distribute the load.

3.10 FINISH GRADING

- A. Final Contours: Perform finish grading and blend into conformation with remaining natural ground surfaces.
 - 1. Leave all finished grading surfaces smooth and firm to drain.
 - 2. Bring finish grades to elevations within plus or minus 0.10 foot of existing or contours shown.
- B. Surface Drainage: Perform grading outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish

grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water

3.11 RESPONSIBILITY FOR AFTERSETTLEMENT

- A. Aftersettlement Responsibility: Take responsibility for correcting any depression which may develop in backfilled areas from settlement within one year after the work is fully completed. Provide as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

3.12 INSPECTION AND TESTING OF FILLING

- A. Sampling and Testing: Engage an independent testing laboratory to perform all sampling, testing, and laboratory analysis in accordance with the appropriate ASTM Standard Specification. Provide compaction testing of all in-place backfill after every 400 feet of pipe installation. Record in-place fill compaction values at 50-foot intervals. Additionally, record compaction values at a minimum of 10 feet and 5 feet below final surface elevation and at the surface at each location. Record in-place fill compaction values at a minimum of 10 feet and 5 feet below final surface elevation and at the surface at all road/driveway crossings. Record in-place fill compaction values a minimum of 10 feet and 5 feet below final surface elevation and at the surface at 25-foot intervals through roadway/parking areas. Submit copies of all fill tests to the Engineer. If testing reveals non-compliance with Contract requirements, all additional testing and placement of adequately compacted fill will be made at the Contractor's expense.
- B. Correction of Work: Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating, or sprinkling as needed and recompaction in place prior to placement of a new lift.

END OF SECTION 31 23 23

(NO TEXT FOR THIS PAGE)

SECTION 31 25 00 – EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The following Sections and general provisions apply to this Section.
 - 1. 31 10 00 "Site Clearing".
 - 2. 31 23 16.13 "Trenching".
 - 3. 31 23 23 "Fill".

1.2 SUMMARY

- A. Section includes Temporary control measures as shown on the plans or as ordered by the Owner during the life of the Contract to control water pollution, soil, erosion, and siltation using berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

1.3 DESCRIPTION

- A. This item shall consist of temporary control measures as shown on the Drawings or as ordered by the Owner during the life of the Contract to control water pollution, soil erosion, and siltation using berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.
- B. Temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this Contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.
- C. Temporary control may include work outside the construction limits such as borrow pit operations, equipment, and material storage sites, waste areas, and temporary plant sites.

1.4 SUBMITTALS

- A. Submit Erosion Control Plan Product Cut Sheets to Engineer for review and approval.
- B. Prior to start of construction, Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, and construction. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction have been accepted by the Engineer.

PART 2 - PRODUCTS

2.1 MULCHES

- A. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.

2.2 STRAW BALE DIKE

- A. Straw bale dikes shall be used as needed to prevent soil erosion at all stream or ditch crossings.

2.3 OTHER

- A. All other materials shall meet commercial grade standards and shall be approved by the engineer before being incorporated into the project.

PART 3 - EXECUTION

3.1 GENERAL

- A. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.
- B. The Contractor shall be responsible for compliance to the extent that construction practices, construction operations, and construction work are involved.

3.2 AUTHORITY OF OWNER

- A. The Owner and the Owner's authorized Representatives have the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow, and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams.

3.3 CONSTRUCTION DETAILS

- A. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding, mulching, and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.
- B. Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.
- C. The Owner will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.
- D. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or as ordered by the Owner, such work shall be performed by the Contractor at his/her own expense.
- E. The Owner may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.
- F. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

- G. Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures must be provided and not alter watercourse flow or sedimentation
- H. Pollutants including fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

END OF SECTION 31 25 00

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Chain-link fences.
 - 2. Swing, manually-operated gates.

1.3 REFERENCES

- A. American Society of Civil Engineers
 - 1. ASCE/SEI 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- B. ASTM International
 - 1. ASTM F 567 - Standard Practice for Installation of Chain-Link Fence
 - 2. ASTM F 1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.5 DESIGN

- A. General: Provide fencing of the chain-link type and six (6) feet high with six (6) feet of diamond mesh woven wire fabric topped by extension arms with a vertical height of approximately one foot above the top of the fabric, unless shorter to match existing as denoted on drawings. Design the extension arms to carry three double strands of barbed wire. Locate the fence as shown.

- B. Fabric, Supports, and Fittings: Provide black color coated steel fabric, supports and fittings. Coat the framework, posts and hardware except hinges and latches to match the fabric with thermoplastic or thermoset resins and provide oven baked materials to a minimum dry coating of seven (7) mils. Color coat all accessories except hinges and latches to match the fence. Provide aluminum hinges and latches.
- C. Pipe Sizes and Weights: Provide pipe sizes and weights meeting the requirements of ASME B 36.10, Table 2 and ASTM A 53, Table 1. All pipe sizes listed are nominal, unless otherwise indicated.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle all pipe, fittings and appurtenances as specified in Division 01 and as follows.
- B. Upon receipt at the job site, check and inspect all materials to ensure that no damage occurred during shipping or handling. Store materials in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism, and theft.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
- B. Fences and Gates
 - 1. K&M Fencing
 - 2. Or Approved Equal

2.2 FABRIC

- A. Provide fabric that is one piece woven 2-inch mesh chain link of 9-gauge galvanized steel wire with a minimum breakload of 1800 lbs/ft for vinyl coated steel 2170 lbs/ft for galvanized steel and which is interwoven to form a continuous fabric with no splices is coated after weaving. Provide the top selvage twisted and barbed and the bottom selvage knuckled. Clean the fabric of all grease and foreign matter before coating and shipping. Stretch the fabric tightly approximately two (2) inches above grade level and attach the fabric to the terminal or gate posts using beveled tension bands and tension bars.

1. Provide galvanized fabric that is fusion coated with a minimum seven mil coating of polyvinyl chloride (PVC) applied over a thermoset plastic bonding agent. Conform the PVC to Federal Specification RR-F-191.
2. Vinyl coat all cut ends.
3. Conform aluminum fabric to Fed. Spec. RR-F-191.

2.3 BARBED WIRE

- A. Provide barbed (where noted on the plans) wire consisting of three strands of 0.110-inch diameter wire with 12-1/2 gauge galvanized steel wire with 4-point round barbs spaced not more than five (5) inches apart.
 1. Provide barbed wire for vinyl coated fence, finished with color coating as specified for the fabric. Provide uncoated barbs.

2.4 TENSION WIRE

- A. For the tension wire for the fence bottom use a minimum 7-gauge galvanized coil spring steel.

2.5 TOP AND BRACE RAILS

- A. General: Furnish the top rail in approximately 20-foot lengths with couplings approximately 6 inches long for each joint. Provide one coupling in each 5 with an expansion spring. Provide the rail continuous from end-to-end for each run of fence. Provide brace rails at all terminal posts, located the rails midway between the top and bottom of the fabric and extend from the terminal post to the first adjacent line post. Securely fasten rails at both ends. Provide top and brace rails of the same material as the fabric.
- B. Pipe Type: Top rail to be 1-5/8-inch OD.

2.6 POSTS

- A. General: Provide all posts that are galvanized steel pipe, or coated as specified for vinyl coated framework, posts and hardware in Paragraph 1.5.
- B. Pipe Posts: Provide pipe posts as follows:
 1. For end, corner and pull posts use 2-7/8-inch, Schedule 40 pipe. Length of terminal posts and pull post to be approximately 3 feet 6 inches longer than height of fabric.
 2. For line posts use 2-inch, Schedule 40 pipe.
 3. For gate posts use the following pipes for different leaves:

| <u>Width of Gate Leaf</u> | <u>Nominal Minimum Post Size</u> | <u>Minimum Depth into Concrete</u> |
|---------------------------|--------------------------------------|--|
| up to 6'-0" | 2-1/2-inch Schedule 40 | 36" |
| over 6'-0" to 12'-0" | 3-1/2-inch Schedule 40 | 36" |
| over 12'-0" to 18'-0" | 6-inch Schedule 40 | 48" |
| over 18'-0" to 23'-0" | 8-inch Schedule 40 | 48" |
| over 23'-0" to 30'-0" | 10-inch Schedule 40 | 48" |

4. Bending Strength: Provide materials with the minimum bending strength based on a 6-foot cantilever for rolled formed or tube posts as follows:

| | <u>Minimum Bending Strength, lbs Galvanized Steel</u> |
|--|---|
| 1. End, Corner and Pull Posts: 2.875-inch OD roll formed or | 444 |
| 2. Line Posts: For fences 8 feet maximum height 1.875- by 1.625-inch C- Section | 245 |
| 3. Gate Posts: For leaves up to 6 feet wide 2.875-inch OD roll formed | 444 |

2.7 GATES

- A. General: For the perimeter construction of gates with leaves up to 6 feet wide, use 1-1/2-inch Schedule 40 pipe and for gates with leaves greater than 6 feet wide, use 2-inch Schedule 40 pipe.
- B. Braces: Provide the gates with sufficient horizontal and vertical members and bracing to ensure structural stability to prevent sagging and to provide for the attachment of fabric, hardware and accessories. Provide gates with diagonal cross bracing consisting of 3/8-inch diameter adjustable length truss rods where necessary to provide frame rigidity without sag or twist.
- C. Gate Accessories: Equip gates with hinges, latches, center stops, hasps, holdbacks, and padlocks. Provide hinges, latches, center stops, hasps, and holdbacks that are galvanized steel after fabrication. Provide double gates with a center drop bar and gate holdbacks.
- D. Latches: Provide gate latches that are positive locking, pivoting type with the padlocking arrangement accessible from either side of the gate.

- E. Padlocks: Provide manipulation-resistant combination padlocks of solid brass pin tumbler type with hardened steel or brass shackles as scheduled and with size and shackle opening to equal the specified product.
- F. Hinges: Hang all gates on offset hinges to permit swinging the gate through a 180-degree arc to lie, when not obstructed, along and parallel to the line of the fence.
- G. Barbed Wire: Top gates with barbed wire on extension arms to same as specified for the fence.

2.8 ATTACHMENTS

- A. General: Provide all attachments fabricated to match the fabric as specified for framework, posts and hardware in Paragraph 1.5, except provide aluminum hinges and latches.
- B. Tension Bars: Provide 3/16-inch by 3/4-inch galvanized steel tension bars attached to the terminal posts by means of beveled edge bands.
- C. Truss Rods: Provide 3/8-inch diameter galvanized steel truss rods. Securely mount truss rods between the line post end of the brace rail and the base of the terminal post.
- D. Post Tops: Provide post tops of galvanized steel to form weathertight caps. Make provisions for installation or passage of the top rail.
- E. Brace and Tension Bands: Provide galvanized steel brace bands and tension bands of the "unclimbable" beveled edge type with 3/8-inch diameter square shouldered aluminum carriage bolts, nonremovable from outside of the fence.
- F. Rail Couplings: Provide rail couplings of the outside sleeve type, not less than six inches long, self-centering, which allows for expansion and contraction. Provide galvanized steel rail couplings.
- G. Fabric Ties: Provide 11-gauge galvanized steel fabric ties.
- H. Hog Rings: Provide 11-gauge wire, aluminum alloy, Type 6061-T6 hog rings.
- I. Extension Arms: Provide galvanized steel extension arms for supporting the barbed wire. Design the arms with an adequate cross section to withstand without failure or permanent deflection a perpendicular force of 250 pounds applied at the end of the arm when the arm is securely attached to the post. Construct extension arms to be slanted out.
 - 1. Provide Vee-type arm at 45 degrees to vertical with a vertical height approximately one foot above the top of the fabric, one for each post.

2.9 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
 - 1. Design Wind Load.
 - a. Minimum Post Size: Determine according to ASTM F 1043 for post spacing not to exceed 10 feet for Material Group IA, ASTM F 1043, Schedule 40 steel pipe.
 - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
- C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading is completed unless otherwise permitted by Engineer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. General: Install chain-link fencing according to ASTM F 567 and manufacturer's requirements specified. Do not begin installation and erection before final grading is completed, unless otherwise approved.

- B. Install fencing on established boundary lines inside property line as shown on Drawings.
- C. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated in Drawings, in firm, undisturbed or compacted soil.
 - 1. If not indicated, excavate holes for each post to the minimum diameter recommended by the fence manufacturer, but not less than four times the largest cross-section of the post.
 - 2. Unless otherwise indicated, excavate the hole depths approximately 3 inches lower than the post bottom, with the bottom of posts set not less than 36 inches below finished grade.
- D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
 - b. Concealed Concrete: Place top of concrete 2 inches below grade as indicated on Drawings to allow covering with surface material.
 - c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
 - d. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
- E. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment as indicated on Drawings. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- F. Line Posts: Space line posts uniformly at 10 feet o.c.

- G. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid height of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- I. Intermediate and Bottom Rails: Secure to posts with fittings.
- J. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- K. Barbed Wire: Firmly install the barbed wire in slots in the extension arms, anchored to the terminal extension arms after removal of all sag from the wire.
- L. Tension Wire: Attach the tension wire to the bottom of the fabric by hog rings spaced at 24-inch intervals and to terminal posts by brace bands.
- M. Fabric: Leave approximately 2 inches between finished grade and the bottom selvage, unless otherwise indicated. Pull the fabric taut and tie to posts, rails, and tension wires. Install the fabric on the security side of the fence, and anchor the fabric to the framework so that the fabric remains in tension after the pulling force is released.

3.4 GROUNDING AND BONDING

- A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Fence and Gate Grounding:
 - 1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
 - 2. Install ground rods and connections at maximum intervals of 1500 feet.
 - 3. Fences within 100 feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - 4. Ground fence on each side of gates and other fence openings.
 - a. Bond metal gates to gate posts.

- b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
 - C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.
 - D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.
 - E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
 - 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
 - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
 - F. Connections:
 - 1. Make connections with clean, bare metal at points of contact.
 - 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 4. Make above-grade ground connections with mechanical fasteners.
 - 5. Make below-grade ground connections with exothermic welds.
 - 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.
- 3.5 ADJUSTING
- A. Lubricate hardware and other moving parts.

END OF SECTION 32 31 13

(NO TEXT FOR THIS PAGE)

SECTION 32 90 00 – LANDSCAPING WORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Soil, soil preparation, soil tests, excavation, planting, seeding, sodding, pruning, edging, fertilizing and maintenance.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 31 23 16 - Excavation, Earth and Rock
2. Section 31 23 23 - Backfilling

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM C 33 - Specification for Concrete Aggregates

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Soil Tests: Submit soil test results.

C. Maintenance Instruction Manual: Upon completion of the landscaping work and prior to final payment, furnish a landscaping maintenance manual. Include complete and detailed instructions on the recommended maintenance procedure to be followed for maintaining lawns and each species of plant material. Include a schedule of all planted and seeded materials and all pertinent growing and maintenance information and requirements for watering, fertilizing, lime applications, spraying, cultivating, pruning and weed control.

1.4 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

B. Top Soil: Deliver top soil in a dry state without enough moisture to allow it to be packed or squeezed into a ball.

C. Balled and Bare Root Plants: Immediately after delivery, set all balled plants on the ground with the balls well protected with soil. Water and properly maintain all plants until planting. Plant or heel in bare rooted plants which cannot be planted immediately upon delivery. No materials heeled in for more than a week may be used. Before the roots are covered, open bundler and separate the plants.

D. Grass Seed: Deliver grass seed in standard size bags of the vendor, showing weight, analysis and name of vendor. Store the seed so as not to impair its effectiveness.

E. Sod: Deliver sod to the site in fresh condition and within two days of the time it has been dug.

F. Fertilizer: Deliver fertilizer mixed as specified, in standard size bags, showing weight, analysis and the name of the manufacturer. Store the fertilizer in a weatherproof storage place in a manner that will keep it dry without affecting its effectiveness.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Seeding and Sodding: Sow grass seed between August 15th and October 15th unless sowing between March 15th and June 1st is permitted. Sow seed when the wind velocity is below 5 mph. Place sod between August 15th and October 15th or between March 15th and June 1st, or during the season or seasons which are normal for such work as determined by weather conditions and accepted practice in the locality and as approved.

B. Planting: Unless otherwise directed, plant deciduous material from March 1st to June 1st and from September 1st to December 1st. Plant evergreen material from April 1st to June 1st and from September 1st to November 1st.

1.6 WARRANTY

A. General: Apply the warranty to all seeded, sodded and planted areas. Have the warranty period commence after the final acceptance of all landscaping work exclusive of all replacement plant materials.

B. Plant Material: Warranty plant materials for a period of one year.

C. Seeded Areas: Warranty seeded lawn areas to the time of establishment of an acceptable uniform stand of grass.

D. Sod: Warranty sod to 30 days following the first cutting.

1.7 MAINTENANCE

- A. General: Maintain all seeded, sodded and planted areas during the warranty period.
- B. Grass Areas: Maintain all seeded and sodded areas to well establish a uniform stand of weed-free grass. Reseed or resod areas failing to develop a uniform stand.
- C. Trees, Shrubs and Ground Covers: Cultivate trees, shrubs and ground covers and weed and water when necessary, but not less than twice a month, to prevent plant material from dying. Replace any plant material which is found to be dead or dying during the warranty period to original specifications upon request. Include the full cost of replacing dead or dying plant material in the Contract Amount. No separate payment will be made for replacements. Maintain plant material to be alive, in good growing condition and free of weeds.
- D. Replacement: Replace plant material and resod or reseed only during the specified planting seasons and warranty the replacement material for the same period of time as the original material.

PART 2 PRODUCTS

2.1 SOIL

- A. Topsoil: Provide a natural friable top soil of the region, rich in organic matter, without any material toxic to plant growth and of uniform quality, free of large roots, sticks, hard clay, weeds, brush, stones over 1-inch in maximum dimension or other litter or waste products. Provide topsoil containing no decomposed stone, salts or alkali, and not less than 15 parts per million of available nitrates, 3 parts per million of available phosphorus, 15 parts per million of potash, and having a pH of not less than 6.0 nor more than 7.2 at a depth of 8 inches below the surface of the field from which it is removed. Provide topsoil with a mechanical analysis as follows:

| Sieve | Percentage Passing |
|----------|-----------------------|
| 1 inch | 100 |
| 1/4 inch | 97-100 |
| No. 100 | 40- 60 |

- B. Planting Soil: Prepare planting soil by mixing 10 parts of topsoil with fertilizer and 1 part of peat moss.

2.2 GRASS SEED AND SOD

A. Grass Seed: Provide a fresh, clean, new crop of grass seed composed of 35 percent Pennlawn Fescue and 15 percent Red Top and 50 percent Improved Kentucky Blue Grass. Provide seed components free of noxious weed seeds and having not less than the following purity and germination:

| Component | Percent Purity | Percent Germination |
|---------------------|----------------|---------------------|
| Pennlawn Fescue | 95 | 85 |
| Improved Blue Grass | 85 | 75 |
| Red Top | 75 | 70 |

Tag each sack in accordance with the agricultural seed laws of the United States and the State of Indiana. Show on each tag the producer's guarantee as to the year grown, the percentage of purity, the percentage of germination and the tests by which the percentages were determined. Provide seed for this project having a test date within 6 months of the date of sowing.

B. Sod: Provide nursery-grown Improved Kentucky Blue Grass sod, free of weeds, a minimum of 1-inch thick of dense growth and cut with sharp edges in 18-inch widths and not less than 3 feet long. Sod which has been grown on peat or which has been dug more than two days previous to delivery or which has been allowed to have the roots dry out or on which the grass has turned brown will not be accepted.

2.3 PLANT MATERIALS

A. General: Provide plant materials that are true to species or variety, sound, healthy, vigorous acclimated plants free from defects, disfiguring knots, sun-scaled injuries, abrasions of the bark, plant diseases and insect eggs, borers and all other forms of infestations. Provide material that has normal, well-developed branch systems and vigorous root systems and that is freshly dug, nursery-grown stock grown under the same climatic conditions as the Project location. Provide material grown under climatic conditions similar to those in the locality of the project for at least 2 years and transplanted or root pruned at least in the last 3 years.

B. Plant Size: Dimension a plant as it stands in its natural position. Measure trees under 4 inches in caliper at a point 6 inches above the ground and trees more than 4 inches in caliper at a point 12 inches above ground. Provide the stock of a fair average of the minimum and maximum sizes specified. Do not cut back large shrubs to sizes specified.

C. Balled, Burlapped and Platformed Plants: Dig balled and burlapped, as well as balled and platformed, plants with sufficient roots and a solid ball of earth securely held in place by burlap and stout natural fiber rope. Manufactured balls are not acceptable.

Provide balled and platformed plants with sturdy platforms of a size equal to the diameter of the horizontal midsection of the ball of earth.

D. Bare-Rooted Plants: Dig bare-rooted plants with sufficient root spread and depth to ensure full recovery and development of the plants. Cover roots for these plants with a uniformly thick coating of mud by being puddled immediately after they are dug.

E. Inspection: Submit plants to inspection for approval at the place of growth, for conformity to specification requirements as to quality, size and variety. In addition to the place of growth inspection, submit plants to inspection for approval upon delivery at the project site or during the progress of the work, for size and condition of balls or roots, diseases, insects, and latent defects or injuries. Remove rejected plants immediately from the site. Do not substitute plants for those specified unless approved.

2.4 COMMERCIAL FERTILIZER

A. Provide all commercial mixture fertilizer uniform in composition, free flowing, conforming to state and federal laws and suitable for application with equipment designed for that purpose. Provide fertilizer with organic, inorganic or combined elements with the following composition by weight:

| | | |
|----|----------------------|--------------------|
| 1. | Nitrogen | 12-parts by weight |
| 2. | Phosphorus pentoxide | 12-parts by weight |
| 3. | Potash | 12-parts by weight |

B. Incorporate into the topsoil as specified at the rate of 600 pounds per acre by mechanical spreader. The fertilizer shall be uniformly worked in to the top 4-inches of topsoil.

2.5 ACCESSORIES

A. Tree Wrap: Provide new, clean, plain, 8-ounce weight burlap material 6 inches wide for wrapping tree trunks.

B. Weed Barrier Fabric: Provide Pro-5 fabric as manufactured by the DeWitt Co., or equal.

C. Gravel: Provide smooth river bed gravel of solid or mixed color range to be as selected and meeting the requirements of ASTM C 33 and graded according to Size No. 467, Table II.

D. Mulch: Provide ground corn cobs, wood chips, tree barks, buckwheat hulls or other approved materials for mulch.

E. Edging: Provide commercial hot-rolled steel edging plate, 4 inches wide and 1/8-inch thick. Fabricate edging in sections with loops pressed from or welded to the face of sections at 30-inch centers to receive 16-inch long tapered steel stakes. Provide edging finished with the manufacturer's standard paint.

2.6 TESTS

A. Sample: Submit a 10-ounce sample of the proposed topsoil to a testing laboratory in sealed containers to prevent contamination.

B. Analysis: Analyze the topsoil sample to determine the amount of lime necessary and the appropriate fertilizer mix and quantity required for planting, seeding and sodding.

PART 3 EXECUTION

3.1 GRADES

A. General: Existing and final contours shown depict finished grades after completion of landscaping work.

B. Lawn Grades: Grade lawns to meet walks, curbs and adjoining surfaces after uniform settlement of surfaces. Correct water pockets or ridges which appear after surface settlement takes place on or before the end of the guarantee period.

3.2 EXCAVATION FOR PLANTING

A. General: Obtain approval for all plant locations before excavation. Remove from the site all material that is surplus and unsuitable for backfill.

B. Ground Cover and Grass Areas: Excavate for ground cover and grass areas to the required depths for grass to receive 6 inches of topsoil and for groundcover to receive 6 inches of planting soil.

C. Plant Pits: Excavate plant pits with vertical sides and a circular outline.

1. Dig tree and evergreen pits at least twice the diameter of the ball, and deep enough to permit an 8-inch layer of compacted planting soil beneath the ball.

2. Dig shrub pits a minimum of twice the diameter of the ball and deep enough to allow 6 inches of compacted planting soil beneath the ball.

D. Drain: Install french drains for all trees, ornamental trees, and evergreens planted on berms and other locations where the grade permits, from bottom of planting pit to the finished grade with a trench 9 inches wide, filled with a 6-inch thick layer of 3/4-inch

washed gravel. Cover the gravel layer with a filter mat before backfilling the trench with soil.

3.3 SOIL CONDITIONING

A. Disking: Before the application of topsoil, sodding or seeding, disk the area to be seeded, sodded or planted with groundcover to a depth of 6 inches. Continue the disking until the subsoil surface is sufficiently broken to provide a good bond between subsoil and topsoil. Spread 6 inches of planting soil over the disked area to a uniform depth and density.

B. Ground Limestone: Incorporate ground limestone, if required by the results of the soil test report, into the upper 3 inches of planting soil. Uniformly spread fertilizer and mix into the soil to a depth of 1-1/2 inches or as recommended by the manufacturer.

3.4 SEEDING AND SODDING

A. Seeding: Sow seed at the rate recommended by the seed producer. Evenly rake the surface after seeding with a fine-tooth rake. Mulch all newly seeded areas and cover with a minimum of 1/4-inch of straw or hay, approximately at the rate of 1 bale per 1,000 square feet, then thoroughly wet.

B. Sodding: Lay sod in such a manner that the surface is smooth and even and all edges abut one another tightly. Water and roll sod so that a bond is produced between the prepared topsoil and the sod. On slopes greater than 3 to 1, stake installed sod with approved wooden sod stakes at a minimum rate of three stakes per square yard of sod.

3.5 PLANTING

A. Layout: Outline locations for trees, shrubs, evergreens and bed and stake for approval. Obtain location approval prior to commencing planting operations.

B. Setting Plants: Set plants plumb and straight with the crown at finished grade. Compact soil around the base of the ball, and fill the void 3/4 of the way up from the bottom. Water each plant immediately. After the water has completely drained, fill the plant pits to finished grade. Properly spread out roots of bare root plants and carefully work topsoil among them. Cut off any broken or frayed roots with a clean cut. Form a shallow basin, the size of the ball with a ridge of soil to facilitate watering. After that operation is completed, apply a second watering immediately. Finish all planting pits and beds within a period of 3 days following installation. Construct tree saucers, cultivate and outline planting pits with a neat edge, when necessary.

C. Mulching: Immediately after planting operations are completed, cover all tree and shrub pits with mulch to a minimum depth of 2 inches. Limit mulch for trees to saucer diameter and, for shrubs, the entire shrub bed.

D. Pruning: Prune each tree and evergreen with clean, sharp tools in accordance with standard horticultural practice to preserve the natural character of the plant. Remove suckers and all dead, broken or badly bruised branches.

E. Wrapping: Wrap the tree trunks of all trees with burlap tree wrapping securely tied with suitable cord at top and bottom and at 2-foot intervals along the trunk. Overlap the wrapping 2 inches top and bottom and entirely cover the trunk from the ground to the height of the second branch, neat and snug.

F. Guying: Guy trees as necessary to be plumb and straight through final inspection. Remove guy wires at completion of project.

G. Watering: During planting, thoroughly saturate the soil around each plant with water and as many times later as seasonal conditions require until the end of the guarantee period.

3.6 EDGING

A. General: Establish a neat edge where planting areas meet grass areas, with spade or edging tools, immediately after all planting and seeding is completed. Establish good flowing curves as shown. Maintain edging until the end of the guarantee period.

3.7 GRAVELED AREAS

A. General: Lay a weed barrier in accordance with the manufacturer's recommendations and top with a 4-inch layer of gravel. Edge graveled areas with metal edging.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 01 10.58 - DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following: Disinfection of all pipelines, tanks, structures, conduits and equipment which are to store, handle or carry potable water. Furnish all labor, water, chemicals and equipment, including taps, corporation stops, temporary pumps and other items necessary to perform the Work, except as otherwise specified.

1.3 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. AWWA C651 - Disinfecting Water Mains
 - 2. AWWA C655 - Field Dechlorination

1.4 QUALITY ASSURANCE

- A. Disinfection Standards: Disinfect in accordance with AWWA C651 for water mains.
 - 1. Prior to disinfecting contact Local Health Department to determine disinfection requirements and then compare them to AWWA C651. Disinfect in accordance with whatever standard is more stringent.
- B. Chlorinated Water Disposal: Dispose of old highly chlorinated water in accordance with applicable regulations and the AWWA C655 Field Dechlorination Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 APPLICATION

- A. Flushing: Flush water mains and fire hydrants prior to disinfection. Flush water mains with a flushing velocity of at least 2.5 feet per second. The following are flows required to provide a flushing velocity of 2.5 feet per second. Flush water mains and hydrants until the water discharged is clear.

| <u>Pipe Size</u> | <u>Inside Diameter</u> | <u>Flow at a Velocity of 2.5 Feet per Second</u> |
|------------------|------------------------|--|
| ½" | 0.622" | 2.4 gpm |
| ¾" | 0.824" | 4.2 gpm |
| 1" | 1.05" | 6.8 gpm |
| 1¼" | 1.38" | 12 gpm |
| 1½" | 1.61" | 16 gpm |
| 2" | 2.07" | 27 gpm |
| 2½" | 2.47" | 38 gpm |
| 3" | 3.07" | 58 gpm |
| 4" | 4" | 98 gpm |
| 6" | 6" | 220 gpm |
| 8" | 8" | 390 gpm |
| 10" | 10" | 620 gpm |
| 12" | 12" | 880 gpm |
| 14" | 14" | 1,200 gpm |
| 16" | 16" | 1,600 gpm |
| 18" | 18" | 2,000 gpm |
| 20" | 20" | 2,500 gpm |
| 24" | 24" | 3,600 gpm |

- B. Disinfection Procedures for Piping: Disinfect by the continuous feed method, as specified in AWWA C651, using sodium hypochlorite solution. Then add chlorinated water containing not less than 50 mg/L free available chlorine followed by clean water at one end of the section being disinfected and discharged at the far end.
1. Add the chlorinated water until the water coming from each downstream blowoff has a residual of not less than 25 mg/L of free chlorine.
 2. Close the pipelines and allow the solution to remain in the lines for at least 24 hours. Recheck the chlorine residual in the pipeline. If the free chlorine residual is less than 10 mg/L after 24 hours, disinfect the pipelines again with more concentrated chlorinated water.

3. After meeting the previous requirements in this subsection and after a 24-hour holding period, thoroughly flush out the pipelines and equipment and fill with clean water. Do not permit flushing water to discharge into existing water mains. The water for this filling will be furnished by the Contractor.
4. After testing has concluded, dispose of chlorinated disinfection waters in an appropriate manner. If the water is discharged in an open channel or storm sewer, dechlorinate the disinfection waters to 0.05 mg/L of total chlorine.
5. If the chlorinated water is discharged directly to open drains, the chlorine shall be removed through the use of dechlorination tablets in a mesh bag or other acceptable means/methods to remove the chlorine.

3.2 VERIFICATION OF DISINFECTION

- A. Final Samples: Bacteriological samples will be taken by the Contractor with supervision from the Owner's representative on two successive days. Package and send samples to laboratory for bacteriological testing. If the samples are not satisfactory, repeat the entire disinfection procedure.
 1. Assume the expense of taking and testing additional samples until satisfactory samples are obtained.
 2. Assume the expense of all water for subsequent fillings of the pipelines, tanks and equipment.
 3. Hose connections on fire hydrants shall not be used for collecting samples. Contact the applicable regulatory agency for sampling criteria and procedures.

END OF SECTION 33 01 10.58

(NO TEXT FOR THIS PAGE)

SECTION 33 01 30.13 - SANITARY SEWER, FORCE MAIN AND MANHOLE TESTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. List of testing equipment for sanitary gravity sewers, force mains, and manholes
2. Operating procedures for testing equipment.

1.2 REFERENCE STANDARDS

A. ASTM International

1. ASTM – D2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
2. ASTM – F1417 Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
3. ASTM – C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

PART 2 – TESTING EQUIPMENT

2.1 GRAVITY SEWER TESTING

A. Vacuum Testing Equipment:

1. Vacuum pump
2. Vacuum line.
3. Vacuum tester base:
 - i. Compression band seal.
 - ii. Outlet port.
4. Shutoff valve.
5. Stopwatch.
6. Plugs.
7. Vacuum gage: calibrated to 0.1 in. Hg.

B. Deflection Testing Equipment:

1. "Go, no go" mandrels.
2. Pull/retrieval ropes.

C. Low Pressure Air Testing Equipment:

1. Plugs
2. Compressor
3. Piping for air lines
4. Pressure gauge

D. Hydrostatic Testing Equipment:

1. Hydrostatic water pump
2. Pneumatic or mechanical plugs
3. Hoses
4. Pressure gauge

E. Valve Testing Equipment

1. Hydrostatic water pump
 2. Pneumatic or mechanical plugs
 3. Hoses
 4. Tools for opening/closing valves
- F. Lamping:
1. Lamp open cut gravity piping after flushing and cleaning.
 2. Perform lamping operation by shining light at one end of each pipe section between manholes.
 3. Observe light at opposite end.
 4. Pipe not installed with uniform line and grade will be rejected.
 5. Remove and reinstall rejected pipe sections.
 6. Reclean and lamp until pipe section is installed to uniform line and grade.
- G. Plugs:
1. Plug outlets, wye branches, and laterals.
 2. Brace plugs to resist test pressures.
- H. Infiltration Testing – Gravity Sewers:
1. Maximum allowable infiltration: 100 gal/in of pipe diameter for each mile per day for reach of piping undergoing testing.
 2. Include allowances for leakage from manholes.
 3. Perform testing with minimum positive head of 2 feet.
- I. Deflection Testing of Plastic Sewer Piping:
- J. Perform Low Pressure Air Test - Gravity Sewers
1. Testing procedure: test gravity sewers using low-pressure air in accordance with ASTM F1417
 - i. Isolate the section of sewer under test using pneumatic plugs that have a sealing length greater than the diameter of the pipe and are capable of resisting test pressure without external bracing or blocking. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line.
 - ii. Introduce low pressure air slowly into the sealed line until the internal air pressure reaches the “starting air pressure” of 4.0 psi greater than the average back pressure of any groundwater above the pipe, but not greater than 6.0 psi.
 - iii. After the starting air pressure is reached, throttle the air supply to maintain that internal pressure for at least two minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.
 - iv. When temperatures have been equalized and the starting pressure stabilized, disconnect the air supply and allow pressure to drop. Observe the continuous monitoring pressure gauge while the pressure is decreased to no more than 0.5 psi from the starting air pressure. The time in minutes required for the pressure to drop 0.5 psi must not be less than as calculated using the following formula.

$$T = 0.085 \times (d) \times (d) \times 60 \times q \times 2 \quad \text{where:}$$

T = shortest time, in minutes, allowed for the air pressure to drop 0.5 psi

$K = 0.000419 \times (d) \times (l)$, but not less than 1.0

Q = leak rate, 0.0015 cubic feet per minute per square feet of internal surface

D = inside pipe diameter, in inches

L = length of pipe being tested, in feet

2.2 PRESSURE TESTING OF BURIED OR EXPOSED FORCE MAINS AND SPECIFIED GRAVITY SEWERS

- A. Pressure test sections of SDR 21 sewer (areas of sewer with less than 10 feet of horizontal separation from water mains) according to Indiana State Code 327.
- B. Completely backfill all harnessed sections of buried piping before such sections are tested.
- C. Pressure test buried or concealed pipelines for leakage by maintaining the fluid in the pipe at the specified pressure for a minimum period of 2 hours and no more than 8 hours.
- D. Pressure test the piping for leakage as a whole or in sections, valved or bulkheaded at the ends. Apply the specified pressure to the piping through a tap in the pipe by means of a hand pump or other approved method. Do not use air for testing.
- E. Test the piping at a minimum of 100 psi, or 1.5 times the upstream pump shut-off head as determined from the pump manufacturer's performance curves, whichever is greater.
- F. Allowable leakage: stop all visible leakage. Do not allow leakage for any piping, as determined by the above test, to exceed the allowable leakage of whichever guideline is more stringent of the following:
- G. As given by the following formula in section 5.2 of AWWA C600:
- H. $L = (S \times D \times (P)^{1/2}) / 148,000$

in which L is the allowable leakage in gallons per hour, S is the length of water main tested in feet, D is nominal diameter of the pipe in inches and P is the average test pressure in psi gauge

2.3 MANHOLE TESTING

- A. If air testing, test whenever possible prior to backfilling in order to more easily locate leaks.
- B. Repair both outside and inside of joint to ensure permanent seal.
- C. Test manholes with manhole frame set in place.
- D. Vacuum testing:
 - 1. Comply with ASTM C1244.
 - 2. Plug pipe openings; securely brace plugs and pipe.
 - 3. Inflate compression band to 40 psi. Create seal between vacuum base and structure.
 - 4. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10 in. Hg.
 - 5. Close valve.

6. Manhole test duration in seconds:

| Depth (ft.) | Diameter (in) | | | | |
|-------------|---------------|----|----|-----|-----|
| | 48 | 54 | 60 | 66 | 72 |
| | Time (s) | | | | |
| 8 | 20 | 23 | 26 | 29 | 33 |
| 10 | 25 | 29 | 33 | 36 | 41 |
| 12 | 30 | 35 | 39 | 43 | 49 |
| 14 | 35 | 41 | 46 | 51 | 57 |
| 16 | 40 | 46 | 52 | 58 | 67 |
| 18 | 45 | 52 | 59 | 65 | 73 |
| 20 | 50 | 53 | 65 | 72 | 81 |
| 22 | 55 | 64 | 72 | 79 | 89 |
| 24 | 59 | 69 | 78 | 87 | 97 |
| 26 | 64 | 75 | 85 | 94 | 105 |
| 28 | 69 | 81 | 91 | 101 | 113 |
| 30 | 74 | 87 | 96 | 106 | 121 |

7. Record vacuum drop during test period.
8. If vacuum drop is greater than 1 in. Hg during testing period, repair and retest manhole.
9. If vacuum drop of 1 in. Hg does not occur during test period, manhole is acceptable; discontinue testing.
- E. If vacuum test exceeds 1 in. Hg drop in specified time after repair, repair and retest manhole.
- F. Repair visible leaks regardless of quantity of leakage.
- G. If test indicates work does not meet specified requirements, remove work, replace and retest.

2.4 Mandrel Test for Select Pipe

- A. A five (5) percent "GO-NO-GO" Mandrel Deflection Test shall be performed on all PVC, HDPE, and PVC composite gravity sanitary sewer pipe.
 - a. Acceptable alternate, which review and confirmation by OWNER and ENGINEER prior, would be CCTV.
- B. These pipes shall be mandrelled with a rigid device sized to pass five percent (5%) or less deflection (or deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade, provided that in the opinion of the ENGINEER sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. If densification, in the opinion of the ENGINEER has not been achieved within the thirty (30) day time frame, the mandrel size shall be increased to measure a deflection limit of three percent (3%).
- C. The mandrel (GO-NO-GO) device shall be cylindrical in shape and constructed with nine (9) or ten (10) evenly spaced arms or prongs. Mandrels with fewer arms shall not be allowed due to being insufficiently accurate. The mandrel diameter dimension "D" shall be equal to the inside diameter of the sanitary sewer. Allowances for pipe wall thickness tolerances or ovality (from

heat, shipping, poor production, etc.) shall not be deducted from the "D" dimension but shall be counted as part of the 5% or lesser deflection allowance. Each pipe material/type required to be Mandrel tested shall be tested with a mandrel approved by the pipe manufacturer and meeting the requirements of this Section. The "D" mandrel dimension shall carry a tolerance of +/- 0.01 inches.

- D. The mandrel shall be hand pulled through all sewer lines and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired to the ENGINEER's satisfaction and retested.
- E. The contact length (L) shall be measured between points of contact on the mandrel arm. The length shall not be less than the required by the ENGINEER.
- F. The CONTRACTOR shall provide proving rings to check the mandrel. Drawings of mandrels with complete dimensions shall be furnished by the CONTRACTOR to the ENGINEER upon request for each diameter and specification of pipe.

2.5 VALVE TESTING

Operate valves in the section under test through several complete cycles of closing and opening. Have the test pressure for each valve, when in the closed position, applied to one side of the valve only. Test each end of the valve in this manner.

- H. Test each valve in the same test pressure as that specified for the pipe in which the valve is installed.
 - 1. Stop all external and internal leakage through the valves.
 - 2. Stop all valve movement or structural distress.

SECTION 33 05 05.31 - HYDROSTATIC TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following: Hydrostatic testing of all finished water mains installed. Furnish all items necessary to perform the Work, except as otherwise specified.

1.3 REFERENCES

- A. AWWA C605-13 - Installation of PVC Pressure Pipe and Fittings
- B. AWWA C906 – Installation of High Density Polyethylene (HDPE) Pressure Pipe and Fittings
- C. AWWA C151 – Ductile Iron Pipe
- D. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
- E. AWWA C502 - Dry-Barrel Fire Hydrants
- F. AWWA C503 - Wet-Barrel Fire Hydrants
- G. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service

1.4 QUALITY ASSURANCE

- A. Test procedures should be performed to meet the requirements of AWWA Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING

- A. Hydrostatic tests shall be performed on all water mains installed. Make arrangements with the Owner and/or Owner's representative for scheduling each test. Each test shall be performed on the day mutually agreed upon and in the presence of the Owner and/or Owner's Representative.
- B. Furnish equipment, temporary piping, pumps, fittings, gauges, and operating personnel necessary to conduct the tests. Coordinate with the Owner and the Engineer to locate hydrant to obtain test water from and maximum flow to be removed from the system.
- C. The water mains may be tested in sections between valves when there is one or more intermediary valves in a water main.
- D. Each section of water main shall be complete and thrust blocks and/or joint restraints shall have been in place prior to being tested.
- E. Expel all air from the water main test section during the filling of the main and prior to the application of test pressure. Tap the water main at high points, if necessary, to release all air from the water main. Plug taps after the test is successfully completed. Plugs shall be watertight.
- F. Test water mains at a static pressure of 150 pounds per square inch over a period of two consecutive hours.
 - 1. Do not allow leakage for water mains to exceed the pound per square inch specified by the following formula in Section 5.2 of AWWA C600.

$$L = \frac{SxDx(P)^{1/2}}{148,000}$$

in which L is the allowable leakage in gallons per hour or the quantity of water supplied to maintain test pressure, S is the length of water main tested in feet, D is the nominal diameter of the pipe in inches, and P is the average test pressure in psi gauge.

- 2. The test will be considered successful when the pressure drop over the test period is the value calculated in Section 3.1.F.1 or less.
- 3. Ensure make-up water is from a measurable source.
- 4. Correction: Repair defects and repeat test until acceptable.
- 5. The maximum length of pipe to be tested shall be 2000 feet.
- G. Hydrostatic Testing Protocol for Directionally Drilled HDPE Pipe

- The pipe shall be hydrostatically tested before being connected to other piping systems. The pipe shall be tested independently of other hydrostatic tests. Hydrostatic testing will consist of filling the constructed pipeline with water taking care to bleed off trapped air. The Contractor shall pressurize the pipe to 150 psi for a minimum of 4 hours to give the pipe time to expand. During this initial 4 hours, make-up water shall be added as needed to maintain the pressure within 5 psi of the specified pressure. At the end of the first 4 hours, the pipe shall be pressurized to the specified pressure and the test commences. The pipeline shall be maintained under the test pressure for a continuous period of between 1 and 3 hours by pumping water into the line at frequent intervals. The volume of water so added to maintain pressure within 5 psi of the specified pressure shall be measured and considered to represent the "leakage" from the line during the interval. The allowable "leakage" for the pipeline shall not exceed the allowances given in the following table.

| Pipe Nominal Size (in) | 1-Hour Test, Allowable Leakage (gal/100 ft of pipe) | 2-Hour Test, Allowable Leakage (gal/100 ft of pipe) | 3-Hour Test, Allowable Leakage (gal/100 ft of pipe) |
|---------------------------------------|--|--|--|
| 3 | 0.1 | 0.15 | 0.25 |
| 4 | 0.13 | 0.25 | 0.4 |
| 6 | 0.3 | 0.6 | 0.9 |
| 8 | 0.5 | 1 | 1.5 |
| 10 | 0.75 | 1.3 | 2.1 |
| 11 | 1 | 2 | 3 |
| 12 | 1.1 | 2.3 | 3.4 |
| 14 | 1.4 | 2.8 | 4.2 |
| 16 | 1.7 | 3.3 | 5 |
| 18 | 2.2 | 4.3 | 6.5 |
| 20 | 2.8 | 5.5 | 8 |
| 22 | 3.5 | 7 | 10.5 |
| 24 | 4.5 | 8.9 | 13.3 |
| 28 | 5.5 | 11.1 | 16.8 |
| 32 | 7 | 14.3 | 21.5 |
| 36 | 9 | 18 | 27 |
| 40 | 11 | 22 | 33 |
| 48 | 15 | 27 | 43 |

- It is understood that the pipe will continue to expand after the initial 4 hours under pressure and throughout the 1 to 3-hour test period. The allowable "leakage" presented in the table above accounts for this expansion and no additional allowable "leakage" will be considered.

3. Under no circumstances shall the total time under the specified test pressure exceed 8 hours. If the test is not completed due to leakage, equipment failure, etc., the test shall be terminated, and the pipeline shall be de-pressurized and permitted to “relax” for a minimum of 8 hours prior to the next testing sequences.
4. If there are no visual leaks or significant pressure drops during the final test period, and the measured "leakage" is less than allowable, the pipeline passes the hydrostatic test.
5. In the event that the “leakage” exceeds the specified allowable, the Contractor shall be responsible to repair or replace the pipeline until the pipeline passes the hydrostatic test.

END OF SECTION 33 05 05.31

SECTION 33 05 07.13 - UTILITY DIRECTIONAL DRILLING

- A. The project superintendent on the horizontal directional drilling (HDD) portion of the work shall furnish satisfactory evidence that he has a minimum of five (5) years of HDD experience and shall have worked on at least two (2) HDD projects in similar ground conditions using similar equipment as required on this project. The machine operator shall have attended training sessions on the equipment to be utilized and shall have at least three (3) years of HDD experience and shall have operated similar machinery on at least one (1) HDD project using similar equipment.
- B. Check selected pipe material for conformance to contract specifications and to certification tests.
- C. Check Manufacturer's requirements for proper pipe handling and storage.
- D. Review pipe installation procedure with the engineer.
- E. Joining Systems
 - 1. If applicable, pipes shall be jointed to one another and to polyethylene fittings by thermal butt-fusion.
 - 2. The tensile strength at yield of the butt-fusion joints shall not be less than the pipe. A specimen of pipe cut across the butt-fusion shall be tested.
- F. Tests
 - 1. General - Tests for compliance with this specification shall be made as specified herein and according to the applicable ASTM specifications. A certificate of compliance with these specifications, along with a report of each test, shall be furnished by the manufacturer for all material furnished under this specification. In addition, the purchaser may, at his own expense, witness inspection and test of the materials.
 - 2. Tensile properties - The tensile strength, yield strength, elongation, and elastic modulus of the pipe shall be determined based on the pipe material.
 - 3. Melt Index - The melt index of the polyethylene resin shall be determined in accordance with ASTM D1238 and shall be equal, or between 0.1 g/10 min. and 1.0 g/10 min.
 - 4. Density - The density of the base polyethylene resin shall be determined in accordance with ASTM D1505 and be equal or between 0.941 g/cc and 0.055 g/cc.
 - 5. Environmental Stress Cracking Resistance - The material shall be tested in accordance with ASTM D1693, condition B. The test reagent shall be igepal co-630 in 25 percent solution by volume. The specimens shall be in the solution not less than 100 hours before reaching a 50 percent failure point (f50).
 - 6. Identify the percent error of the electronic tracking equipment.
 - 7. The completed sanitary sewer must pass a laser test.
- G. Rejection
 - 1. Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.
- H. The polyethylene piping and fittings shall be installed in accordance with ASTM D2774, underground installation of thermoplastic pressure piping, and with the guidelines and recommendations of the manufacturer.

- I. The pipe shall be installed in the location to the line and grade as shown in the drawings with the pipe joints neatly fused together. The sanitary sewer shall be installed at twice the minimum slope of a gravity system per 327 IAC 3-6-12.
- J. Vertical drilled sight holes are required along the path of the sanitary sewer every 30-50 feet to physically check the depth of the auger head as it passes through the hole to determine the grade accuracy.
- K. All materials delivered to the project for work on the project shall be neatly piled. Excavated materials which are not removed from the immediate site of the work shall be kept trimmed up so as to cause as little inconvenience to the owners of neighboring property and to the public, as possible. Gutters, driveways, and street crossings shall be kept clear except when the latter are unavoidably obstructed by open trench.
- L. Excavated material, including but not limited to, pipe, pavement, concrete, and concrete rubble, and masonry units, which is unsuitable for backfill and all excavated material which has not been used for backfill shall, upon completion of the project, be removed from the site of the work by the contractor at his own expense.
- M. Pipe crossing alignment shall be laid out by the surveyor confirming accurate horizontal distances, either physically measured or shot by electronic distance measurement. Entry and exit points shall be located and marked with survey hubs or markers.
- N. The drill and pipe staging areas shall be kept neat and orderly and disturb as little area as possible.
- O. A drilling fluid shall be used in connection with the installation of the proposed pipe into the hole. Prior to installation of the pipe into the hole, the contractor should determine whether a cement or bentonite slurry shall be used as a supplement. If sub-surface conditions contain predominantly clayey soils, then the bentonite slurry should be used. Polymers can be used, if appropriate.
- P. Mud and slurry material displaced by the pipe during installation and during drilling operations shall be deposited in watertight containers and hauled off by a vacuum truck to a certified receiving site.
- Q. Submit a detailed inspection/testing log to idem for the directional drilling installation. The log shall provide the horizontal and vertical coordinates of the auger head as measured in the sight borings, demonstrating that an acceptable and consistent grade was achieved.

SECTION 33 14 13 – PUBLIC WATER UTILITY PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes requirements for the installation and furnishing of all pipe, fittings, and appurtenances necessary to complete work shown or specified.
- B. Related Requirements
 - 1. Section 31 23 23 "Fill".
 - 2. Section 31 23 16 "Excavation".
 - 3. Section 31 23 16.13 "Trenching".
 - 4. Section 33 01 10.58 "Disinfection of Water Utility Piping Systems".
 - 5. Section 33 05 05.31 "Hydrostatic Testing".
 - 6. Section 33 14 19 "Valves and Hydrants for Water Utility Service".

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AAHSTO):
 - 1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASTM International:
 - 1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
 - 3. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

4. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
5. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
6. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
7. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

D. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111 - Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
6. AWWA C606 - Grooved and Shouldered Joints.
7. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
8. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
9. AWWA C702 - Cold-Water Meters - Compound Type.
10. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
11. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
12. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings
13. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

E. National Fire Protection Association:

- F. NFPA 24 – Standard for the installation of Private Fire Service Mains and Their Appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 "Submittal Procedures": Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings, and accessories.
- C. Shop Drawings: Indicate piping layout, including piping specialties. Indicate dimensions, method of field assembly, and components, sizes of appurtenances provided, appropriate fittings, and all options required by the Work.
- D. Manufacturer's Certificate: Certify that the products meet or exceed the specified requirements.

- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- C. Identify, describe, and document unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Mark pipe, fittings, valves and hydrants according to the applicable specification or standard.
- B. The Contractor shall test and disinfect water mains constructed under this Contract, as specified in Section 33 01 10.58.
- C. The Contractor, under supervision of Owner's Representative, shall collect samples of water from water mains constructed after the piping has been disinfected. The Contractor shall submit the samples to the applicable regulatory agency for bacteriological analysis. Collection and submittal of these samples shall meet the requirements of the applicable regulatory agency. If samples do not pass the requirements of the bacteriological analysis, the water main will be disinfected and sampled again. This procedure will be followed until the samples pass the analysis.
- D. A performance test may be required by the Owner, at any time, for each crew installing water mains. Perform these tests at no additional cost to the Owner. When required, test a given section of water main installed by a given crew. The section shall be a continuous section of water main which can be isolated by valves shown on the Drawings. Do not install water mains in other sections until the first section has been successfully tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Block individual and stockpiled pipe lengths to prevent moving.
- C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
- D. Store polyethylene and PVC materials out of sunlight.

1.8 EXISTING CONDITIONS

A. Field Measurements

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

1. All pipe, fittings, valves, hydrants, and appurtenances shall be as shown on the Drawings or as required by the manufacturer's and AWWA specifications. All pipe, fittings, valves, hydrants and appurtenances shall be new and unused.

2.2 BURIED WATER MAIN PIPE AND FITTINGS

A. PVC Water Mains

1. Acceptable manufacturers are listed below. Manufacturers of equivalent products may be submitted.
 - a. Yelomine Pipe and Fittings: NAPCO Pipe and Fittings
 - b. Pipe shall meet the applicable requirements of AWWA, and ASTM D2241. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge pressure, or better. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the Drawings or as required by the manufacturer's and AWWA specifications, shall be included.
 - c. Pipe shall have ductile-iron-pipe-size (DIPS) equivalent outside diameter.
2. Pipe and Fittings
 - a. Materials used for the manufacture of Yelomine pipe and fittings will meet cell classification per ASTM D1784. Pipe and fittings will meet AWWA standards, as applicable.
3. Color Identification
 - a. Blue Yelomine pipe shall be used.
4. Pipe Joints
 - a. Joints must meet or exceed ASTM D3139 standards.
5. Pipe Gaskets
 - a. Gaskets must meet or exceed ASMT F477 standards.

B. PVC Water Mains

1. Pipe

- a. Polyvinyl chloride pipe shall meet the requirements of AWWA C900, DR-25. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the Drawings or as required by the manufacturer's and AWWA specifications, shall be included.
- b. Polyvinyl chloride pipe shall have ductile-iron-pipe-size (DIPS) equivalent outside diameter.

2. Joints

- a. Pipe joints shall be push-on type and meet the requirements of AWWA C900. Do not use solvent-cement joints.

3. Fittings

- a. Fittings shall be polyvinyl chloride and meet the requirements of AWWA C900. Design and manufacture fittings for a pressure rating of 150 psi.
- b. Mark each fitting. Marking shall meet the requirements of AWWA C900.

4. Adapters

- a. Adapters from polyvinyl chloride water mains to victaulic, flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.
- b. Line the inside surfaces of adapters with a single cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of AWWA C104. Coat outside surfaces of adapters with bituminous coating, complying with AWWA C110.
- c. Adapter ends connecting to polyvinyl chloride water mains shall have plain ends or mechanical joints. Mechanical joints shall meet the requirements of AWWA C111.

5. Gaskets

- a. Gaskets for polyvinyl chloride push-on joints shall meet the requirements of AWWA C900. Gaskets for mechanical joints shall meet the requirements of AWWA C111 and ASTM F477. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of AWWA C111.

C. Ductile Iron Water Mains

1. MANUFACTURERS

- a. Acceptable manufacturers are listed below. Manufacturers of equivalent products may be submitted.

- (1) Ductile-iron pipe and fittings.

- (a) American Cast Iron Pipe Company
 - (b) McWane Incorporated
 - (c) United States Pipe and Foundry

- b. Ductile-iron retainer glands.

- (1) 3-inch through 24-inch diameter

- (a) Nappco, Inc. Series 1246
 - (b) Ebba Iron, Inc. Series 100

- (2) larger than 24-inch diameter

- (a) Ebba Iron, Inc. Megalug

- c. Restrained push-on joints.

- (1) U.S. Pipe and Foundry TR Flex
 - (2) McWane Inc. Super-Lock
 - (3) American Cast Iron Pipe Company Lok-Ring or Flex-Ring

- d. Gaskets.

- (1) John Crane, Inc.
 - (2) Garlock Packing Company
 - (3) U.S. Rubber Company
 - (4) American Cast Iron Pipe Company
 - (5) United States Pipe and Foundry
 - (6) McWane Inc.

- e. Coatings and Linings.

- (1) Kop-Coat
 - (2) Tnemec
 - (3) American Cast Iron Pipe Company
 - (4) United States Pipe and Foundry

- 2. MATERIALS

- a. Fittings: Provide all fittings meeting the requirements of AWWA C110/A21.10, unless shown or specified otherwise. Fittings 14 inches and larger require a pressure rating of 150 psi, or as specified, whichever is greater.

- b. Flanged: Where long radius flanged fittings and other flanged fittings not covered in AWWA C110/A21.10 are shown or specified, provide items meeting the requirements of AWWA C110/A21.10 and having laying lengths conforming to ASME B16.1 for 125-pound American Standard fittings.
 - c. Compact Mechanical Joint and Rubber Gasket Joint: Where compact mechanical joint or rubber gasket joint fittings are shown or specified, provide items meeting the requirements of AWWA C153/A21.53.
3. Flanged Joints
- a. Threaded Flanges: Provide threaded, ductile-iron long hub flanges meeting the requirements of AWWA C115/A21.15.
 - (1) Screw flanges on the threaded end of the pipe in the shop.
 - (2) Reface the face of the flange and the end of the pipe together.
 - (3) Design flanges to prevent corrosion of the threads from the outside and to prevent leakage through the pipe threads.
 - b. Facing and Drilling: Provide flanges plain faced and drilled to the requirements of AWWA C115/A21.15, unless special drilling is called for or required. Face flange accurately at right angles to the pipe axis. Drill flanges smooth and true, and cover machined faces with zinc dust and tallow or equivalent material.
 - c. Taps: Tap flanges where tap or stud bolts are required.
 - d. Fasteners: Provide bolts, stud bolts, and nuts meeting the requirements of ASTM A 307, Grade B.
 - e. Gaskets: Provide full-face gaskets for flanged joints on 12-inch diameter and smaller pipe and gaskets of the ring type for flanged joints on larger pipe. Provide flange gaskets meeting the requirements of AWWA C115/A21.15, except make gaskets for gas lines with neoprene and aramid.
4. Rubber Gasket Joints: Provide mechanical joints and push-on type joints meeting the requirements of AWWA C111/A21.11.
5. Harnessing: For ductile-iron pipe and fittings with mechanical joints that require harnessing, provide ductile-iron mechanical joint retainer glands.

6. Coatings: Coat the assembly with two heavy coats of asphalt varnish conforming to AWWA C151/A21.51 after installation.
7. Joint Assemblies: Design the joint assemblies to resist pullout of the joints at the test pressures specified.

2.3 VALVES

- A. Refer to Section 33 14 19 for valve requirements.

2.4 FIRE HYDRANTS

- A. Refer to Section 33 14 19 for fire hydrant requirements.

2.5 TAPPING SLEEVES

- A. Tapping sleeves are not acceptable for connection to transite piping.
- B. Tapping sleeves shall be stainless steel split sleeves. Each sleeve shall have a branch connection with a mechanical joint end. The inside diameter of each branch shall be over-sized to permit entry and exit of tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameters shown in AWWA Standards.
- C. Tapping sleeves for 4-inch through 16-inch pipe shall be mechanical joint type. Design and manufacture tapping sleeves for a working pressure of 200 psi.

2.6 TAPPING SADDLES

- A. Tapping saddles are not acceptable for connection to transite piping.
- B. Design and manufacture tapping saddles for a working pressure of 200 psi. Saddle bodies shall be stainless steel. Saddle straps shall be corrosion resistant steel alloy. Saddle gaskets shall be positively confined O-ring gasket. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameter shown in AWWA Standards.
- C. Each saddle used for making a wet connection shall have a branch connection with a mechanical joint end. The inside diameter of each branch shall be oversized to permit entry and exit of tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1.

- D. Each saddle used for making a dry connection shall have a branch connection with a mechanical joint end. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts and bolts for flange joints shall meet the requirements of AWWA C110 and be zinc-coated alloy steel. Gaskets shall comply with AWWA C110, be full face and rubber, or as approved by the Engineer. Mechanical joints and accessories shall meet the requirements of AWWA C111.
- E. Gaskets used to seal joints between saddle bodies and tapped pipes shall be O-ring type, circular in cross section, and made of natural or synthetic rubber with a Durometer Hardness of 70 ± 5 .

2.7 CUT-IN TEES

- A. Restrained ductile iron couplings shall be used for connection to existing piping. Couplings must be compatible to 2", 4", 6", 8", 10", and 12" diameter piping as indicated and be able to handle a maximum water pressure of 250 psi.
- B. Manufacturers:
 - 1. Ford Meter Box Company – Ductile Iron Wide Range Transition Coupling.
 - 2. Or-equal.

2.8 WATER SERVICES

- A. Pipe shall be High Density Polyethylene.
- B. Fittings and Couplings: Couplings for services shall be copper to copper or copper to iron, as required, and shall meet the applicable requirements of AWWA C800, ASTM B 62 for 85-5-5-5 composition bronze, and ANSI B2.1. Fittings and couplings shall be Ford Products, Pack Type Compression Joints, or approved equal.

2.9 TRACING WIRE FOR METALLIC AND NON-METALLIC PIPE

- A. In open trench installations, #10-gauge solid copper tracing wire, blue in color, shall be attached directly on top of the water main.
- B. Tracing wire shall meet the following specifications:
 - 1. Direct Burial, 21% Conductivity Clad Steel Conductor, Soft Drawn High Strength Tracer Wire.
 - 2. 600# Average Tensile Break Load.
 - 3. Surface legend print on insulating jacket printed at a minimum of every 2 linear feet.
 - 4. 30 mm, Blue, High Molecular Weight-High Density Polyethylene Jacket per ASTM D 1248.
 - 5. 30V rating.

C. Splicing Connectors shall meet the following specifications:

1. SnakeBite brand wire connectors or approved equal.
2. Max. Voltage: 50 V.
3. Connector Size: 1.138" x 1.285".
4. Wide Range: #14-10 solid and stranded copper; #12 steel core tracer wire (380 and 1200 pound).
5. Silicone Sealant Temperature Rating: -45 degrees Fahrenheit to 400 degrees Fahrenheit.
6. Part# 3WB-01 (Blue) or approved equal.

2.10 WATER METERS

- A. All cold water meters shall conform to the AWWA C700 latest revision issued by AWWA. Water meters shall be magnetic-driven, positive displacement meters of the flat nutating disc type. The size, capacity, and meter lengths shall be as specified in AWWA Standard C700 and between 5/8" and 2" in diameter.
- B. Manufacturers:
1. Consult with owner to determine preferred meter.
 2. All meters shall be warranted as follows:

| Size | Low Flow | Low Flow New Meter Accuracy | Low Flow Repaired Meter Accuracy |
|------|-------------|-----------------------------|----------------------------------|
| 3/4" | 1/4 gpm@95% | 5 yrs or 750,000 gallons | 15 yrs or 2,250,000 gallons |
| 1" | 3/8 gpm@95% | 5 yrs or 1,000,000 gallons | 15 yrs or 3,000,000 gallons |

Normal meter operating range shall be as follows:

| Size | Accuracy Range $\pm 1.5\%$ |
|------|----------------------------|
| 3/4" | 3/4 - 30 gpm |
| 1" | 1 - 50 gpm |

3. Meters and meter parts shall be manufactured, assembled, and tested within the United States. Manufacturers may be required to provide proof of where and what percentage of the meter register, chamber, and maincase is manufactured in the United States.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that existing utility water main size, location, and inverts are as indicated on Drawings.
- B. Inspect water main pipe, fittings, and appurtenances prior to installation. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with undamaged and suitable products.

3.2 PREPARATION

- A. Preconstruction Site Video:
 - 1. Take digital video along centerline of proposed pipe trench.
 - 2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
 - 3. Include Project description, date taken, and sequential number in file of each video.
- B. Pipe Cutting:
 - 1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
 - 2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
 - 3. Grind edges smooth with beveled end for push-on connections.
 - 4. For transite water main pipe, refer to Section 02 41 19 "Selective Demolition" regarding safety procedures for handling of transite pipe.
- C. Remove scale and dirt on side and outside before assembly.
- D. Prepare pipe connections to equipment with flanges or unions.

3.3 EXCAVATION

- A. Excavate pipe trench as specified in Section 31 23 16.13 "Trenching" for Work in this Section.
- B. Dewater excavations to maintain dry conditions to preserve final grades at bottom of excavation as specified in Section 31 23 19 "Dewatering".
- C. Provide sheeting and shoring as specified in Section 31 23 16.13 "Trenching".
- D. Place bedding material as specified in Section 31 23 23 "Fill".

3.4 LAYING OF WATER MAINS

- A. Proper tools and facilities shall be provided and used by contractor for safe working conditions.
- B. Lay and maintain pipe to the lines and grades shown on the Drawings or to the minimum depth specified in this Paragraph. Install fittings, valves and hydrants in the locations shown on the Drawings.
- C. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the Drawings or specified by the Engineer.
- D. Unless otherwise specified in 327 IAC 8 or in the drawings, water mains shall be laid at least 10 feet horizontally from any existing sanitary or storm sewer or sewage force main. The distance shall be measured from edge to edge of the pipe. Water mains crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or force main. The 18-inch separation shall apply whether the water main is over or under the sewer or force main. Lay water mains at crossings of sewers and force mains so a full length of water main pipe is centered on the sewer or force main whenever possible. No water main shall pass through or come in contact with any part of a sanitary sewer manhole.
- E. All piping shall be laid at a depth that provides at least 5' of cover. Cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation.
- F. Laying of water mains shall meet the requirements of AWWA C906, unless otherwise specified in this Section.
- G. Shape the bottom of the trench to give uniform circumferential support of the lower quarter of each pipe.
- H. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation.
- I. As each length of pipe is placed in a trench, join the pipe being laid to the previously laid pipe. Bring the pipe to correct line and grade. Secure the pipe in place with bedding tamped under the pipe. Tamp bedding up to the centerline of the pipe.
- J. Deflection from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections that exceed the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.
- K. Provide thrust restraint at horizontal and vertical deflection fittings and at tees, plugs, tapping sleeves and tapping saddles. Restraint shall be mechanical joint piping.

- L. Block the open end of the pipe at the close of each day's work to prevent contamination from dirt or rain water and entry of any animal or foreign material.
- M. Lower pipe, fittings, valves and hydrants into the trench by hand, hoists or ropes or other suitable tools or equipment that will not damage products, coatings or linings. Do not drop or dump pipe, fittings, valves, or hydrants into the trench.
- N. As the water main system is installed, water lines shall be marked with a 2"x4" or other acceptable stake, with a height allowing a minimum of 4'-0" above grade. Stake shall have the uppermost section painted blue and marked with the letter "W" to indicate water line placement.
- O. Wrap Ductile Iron sections of water main with polyethylene wrap to prevent damage from corrosive soils.

3.5 CONNECTING TO EXISTING MAINS

- A. Locate and verify exact size of all existing mains, both horizontally and vertically. Additionally, allow adequate time, after location and prior to making new connections, for changes in the connection location and size. Backfill excavation immediately after main is located and measured.
- B. Make each wet connection with a tapping valve and tapping sleeve. Make connection with cut-in tee if the existing main is asbestos-cement (transite) pipe. Install and hydrostatically test each tapping valve and tapping sleeve assembly prior to tapping existing water main. Inspect each tapping valve prior to tapping existing water main. Open and close tapping valves and inspect tapping valves in opened and closed positions to ensure all parts are in working condition. Inspect each tapping valve immediately before connecting tapping machine to ensure the tapping valve is open. Install watertight plug on the tapping valve outlet and backfill excavation if existing water main is not tapped within 48 hours after installing tapping valve and tapping sleeve or tapping saddle assembly. Install watertight plug on the tapping valve outlet and backfill excavation if new water main is not connected to tapping valve within 48 hours after making tap in existing water main.
- C. Make each dry connection with fittings and valves indicated on the Drawings. Furnish and install sleeves or tees required to complete connections. All required pipe, fittings, valves, tools, and equipment shall be at the connection site prior to starting connection. Wash interior of new pipe, fittings, and valves with a solution containing 50 mg/L of chlorine prior to making connection. Make connections at night and on weekends when required. The Owner will operate existing valves. Install sufficient water main and restrained joints so existing water mains can be up in service immediately after connection is completed. Inspect joints and eliminate leaks immediately after connection is completed and existing mains are put in service. Install watertight plugs on open ends of pipe and valves, and backfill excavation if new water main is not connected to dry connection within 48 hours after completing dry connection.

3.6 JOINTING

A. PVC Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and AWWA C605 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. For restrained push-on joints, move the loose retainer ring into position against the retainer bar on the spigot end of the pipe being installed. Loosely assemble the joint bolts and nuts.
3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

| | | Maximum Offset Based Upon 20-Foot <u>Pipe Length</u> |
|------------------|-----------------------|--|
| <u>Pipe Size</u> | <u>Minimum Radius</u> | |
| 3" | 88' | 27" |
| 4" | 110' | 22" |
| 6" | 165' | 15" |
| 8" | 215' | 11" |

B. PVC Restrained Push-on Joints

1. PVC Restrained Push-On Joints will have the same requirements as listed in this Section for PVC Push-on Joints.
2. PVC push-on joints shall consist of a PVC pipe bell restraint with a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. The product shall be the Megalug restraint harness or an approved equal.
3. For restrained push-on joints, pull the nuts to a uniform tightness by hand or with a short wrench. Do not pull the spigot of the pipe being installed against the back of the bell of the receiving pipe. Engage at least a full nut on each bolt when joint deflection is required.

C. Ductile Iron Mechanical Joint Restraints for PVC Pipe

1. Mechanical Joint Restraint shall be in the Megalug Series or approved equal.
2. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.
3. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

D. Mechanical Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

| <u>Pipe Size</u> | <u>Bolt Size</u> | <u>Torque Range</u> |
|------------------|------------------|---------------------|
| 4" thru 24" | 3/4" | 75 to 90 ft.-lb. |

3. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

| <u>Pipe Size</u> | <u>Maximum Deflection Angle</u> | <u>Maximum Deflection Based Upon 18-Foot Pipe Length</u> |
|------------------|---------------------------------|--|
| 4" | 8° - 18' | 31" |
| 6" | 7° - 7' | 27" |
| 8" | 5° - 21' | 20" |
| 10" | 5° - 21' | 20" |
| 12" | 5° - 21' | 20" |
| 14" | 3° - 35' | 13-1/2" |
| 16" | 3° - 35' | 13-1/2" |
| 18" | 3° - 0' | 11" |
| 20" | 3° - 0' | 11" |

E. Threaded Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not overtighten joints.
3. Backing off made-up threaded joints to facilitate fit-up or alignment will not be permitted.

F. Flange Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not over torque nuts and bolts.

3.7 RESTRAINING AND SUPPORTS

- A. Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the Drawings.
- B. Mechanical Joint Rod Restraint
 - 1. Mechanical joint rod restraint shall be from fitting to fitting.
 - 2. The number of rods shall conform to the follow table.

| <u>Pipe Size</u> | <u>Rod Size</u> | <u>Minimum No. of Rods</u> |
|------------------|-----------------|--------------------------------|
| 4" | $\frac{3}{4}$ " | 2 |
| 6" | $\frac{3}{4}$ " | 2 |
| 8" | $\frac{3}{4}$ " | 4 |
| 10" | $\frac{3}{4}$ " | 4 |
| 12" | $\frac{3}{4}$ " | 6 |
| 14" | $\frac{3}{4}$ " | 6 |
| 16" | $\frac{3}{4}$ " | 8 |
| 18" | $\frac{3}{4}$ " | 8 |
| 20" | $\frac{3}{4}$ " | 10 |

- C. Pipe Supports
 - 1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the Drawings, without causing strain upon pipe, fittings and valves.
 - 2. Support piping by suitable saddle stands, concrete piers or hangers.
 - 3. Locate supports where necessary, at least 8 feet on center.

3.8 INSTALLATION OF TRACING WIRE ON METALLIC & NON-METALLIC PIPE

- A. Tracer wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be secured to the pipe as required to ensure that the wire remains adjacent to the pipe. The tracer wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all tracer wire access points.
- B. Except for approved spliced-in repair or replacement connections, tracer wire shall be continuous and without splices from each tracer wire access point.
- C. Tracer wire access points shall be accessible at all new water valve boxes, water meter boxes, blow-offs, ARVs, fire hydrants, irrigation turnouts and access manholes. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar. Tracer wire access points shall be within public right-of-way or public utility easements.

- D. At the point of connection between ductile iron water mains, with any non-iron water main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of 1/4-inch thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.
- E. Tracer wire shall be laid flat and securely affixed to the pipe at 8-foot intervals. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water service saddles, the tracer wire shall not be allowed to be placed between the saddle and the water main.
- F. At all water main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured to the cap for future connections. The end of the tracer wire shall be spliced to the wire of a six-pound zinc anode and is to be buried at the same elevations as the water main.

3.9 INSTALLATION OF IDENTIFICATION TAPE

- A. Identification tape shall be installed one foot over centerline of pipe unless otherwise noted on plans.
- B. Warning tape shall be installed two feet below final grade over centerline of pipe.

3.10 TESTING

- A. Testing should be completed as specified in Section 33 05 05.31 "Hydrostatic Testing".

3.11 FLUSHING

- A. Flush water mains and fire hydrants prior to disinfection. Flush water mains as specified in Section 33 01 10.58 "Disinfection of Water Utility Piping Systems".

3.12 DISINFECTION

- A. Disinfect all new and repaired water mains prior to placing them in service. Refer to Section 33 01 10.58 "Disinfection of Water Utility Piping Systems" for disinfection requirements.

3.13 COMPLETION SCHEDULING

- A. Complete water mains as they are installed. Test, flush, sterilize, and place in service each part of the water main which is complete and can be placed in service without preventing work to continue on uncompleted parts of the new water mains.

END OF SECTION 33 14 13

SECTION 33 14 19 - VALVES AND HYDRANTS FOR WATER UTILITY SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes requirements for the installation and furnishing of valves, hydrants, and accessories necessary to complete the Work shown or specified.

1.2 DEFINITIONS

1. Abbreviations

- a. ANSI - American National Standards Institute
- b. ASTM - American Society for Testing & Materials
- c. AWWA - American Water Works Association
- d. MSS - Manufacturers Standardization Society of the Valve and Fittings Industry

- 2. Note: All valve sizes on the Drawings or in the Specifications are intended to be nominal size and shall be interpreted as such.

1.3 REFERENCES

A. American Water Works Association:

- 1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- 2. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
- 3. AWWA C502 - Dry-Barrel Fire Hydrants
- 4. AWWA C503 - Wet-Barrel Fire Hydrants
- 5. AWWA C515 - Resilient-Seated Gate Valves for Water Supply Service
- 6. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants
- 7. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
- 8. AWWA C800 - Underground Service Line Valves and Fittings

B. American National Standards Institute:

- 1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

C. ASTM International:

- 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

1.4 SUBMITTALS

- A. Section 01 33 00 "Submittal Procedures".
- B. Product Data: Submit data for valves, hydrants, and all accessories. Provide evidence of compliance with the noted AWWA Standards.
- C. Shop Drawings: Indicate dimensions, method of field assembly and components, sizes of appurtenances provided, and any additional options required to complete the Work.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Provide a certification that all valves and hydrants furnished are manufactured in the United States.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. O&M Manuals: Provide Operation and Maintenance Manuals for the following items.
 - 1. Butterfly Valves.
 - 2. Gate Valves.

1.5 QUALITY ASSURANCE

- A. Mark pipe, fittings, valves and hydrants according to the applicable specification or standard.
- B. Perform Work according to all applicable local, State and Federal standards.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Prepare valves, hydrants, and accessories for shipment according to the applicable AWWA standards.
- C. Seal valve and hydrant ends to prevent entry of foreign matter.
- D. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.
- E. Storage:

1. Store materials in areas protected from weather, moisture, or potential damage.
 2. Do not store materials directly on ground.
- F. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Valves and hydrants shall be as shown on the Drawings or as required by the manufacturer's and AWWA specifications. All valves and hydrants shall be new and unused.

2.2 VALVES

A. Butterfly Valves

1. Butterfly valves and operators shall meet the requirements of AWWA Standard C504. Valves and operators shall be Class 150B.
2. Buried butterfly valves shall have mechanical joints. Mechanical joints shall meet the requirements of AWWA C111.
3. Each buried butterfly valve shall have a manual operator and a 2-inch operating nut. Valve opening direction shall be consistent with operation of existing valves in the distribution system in which the valves are installed, unless otherwise directed by the Engineer.

B. GATE VALVES

1. Buried gate valves 4-inches and larger shall be full ductile iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of AWWA C515 and have mechanical joint ends. Mechanical joints and joint accessories as well as mechanical restraints shall comply with AWWA C111. Valve opening direction shall be consistent with operation of existing valves in the distribution system where the valves are installed, unless otherwise directed by the Owner.
2. Three-inch buried gate valves shall be full ductile iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of AWWA C500 or C509; except, ends shall be screwed. Screwed ends shall conform to ANSI B16.3. Valve opening direction shall be consistent with operation of existing valves in the distribution system where the valves are installed, unless otherwise directed by the Owner.

3. Gate valves 4-inches and larger installed above ground or in structures shall be full ductile iron body, epoxy fusion bonded inside and out, outside screw and yoke gate valves. Valves shall correspond to AWWA C500 or C509. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall be as specified in AWWA C110. Nuts and bolts shall be zinc-coated alloy steel. Gaskets shall be full face and rubber, or as approved by the Engineer.
 4. Gate valves smaller than 4-inch installed above ground or in structures shall be bronze, 125 lb. S.W.P. double disc, screwed-in bonnet, rising stem, inside screw gate valves with screwed ends and malleable iron handwheels. Valves shall meet the requirements of AWWA 509.
- C. Buried valves 2-inch and smaller shall be curb stops. Curb stops shall meet the applicable requirements of AWWA C800, ASTM B 62 for 85-5-5-5 composition bronze, and USAS B2.1. Curb stops shall be Polycam Series 576, Ford B101 Series, or as approved by the Engineer.

2.3 TAPPING VALVES

1. Tapping valves shall comply with both AWWA C500 or C509 and have mechanical joint ends. Double disc gate valve gates, gate rings and body-seat rings shall be oversized to permit entry and exit of tapping machine cutters. Tapping valves shall not be used when connecting to existing transite pipe.
2. Valve end connecting to tapping sleeve shall have a flange for bolting to the sleeve. The flange shall have a tongue which fits a recess in the sleeve. Tongues shall meet the requirements of MSS SP-60. Resilient seated gate valves having a port diameter equal to or exceeding 1/4 inch over nominal diameter shall not require a tongue. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts, bolts, and gaskets for flange joints shall meet the requirements of AWWA C110. Nuts and bolts shall be zinc-coated alloy steel, and gaskets shall be rubber, or as approved by the Engineer. Mechanical joints and accessories shall meet the requirements of AWWA C111. A full nominal diameter cutter shall be used for tapping. Tapping valves installed horizontally shall have rollers and tracks. Gear cases shall be extended type or totally enclosed type. Extended type gear cases shall have bolted side plates to cover stem and stuffing box.

2.4 VALVE BOXES

- A. Valve boxes for butterfly valves and gate valves shall be cast iron. Valve boxes shall be two-piece or three-piece type. Each two-piece box shall be complete with bottom section, top section and cover. Each three-piece box shall be complete with base, center section, top section and cover. Valve boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16-inch. Cast the word "WATER" in each valve box cover.

- B. Valve boxes for curb stops shall be cast iron. Curb boxes shall be extension type. Each curb box shall be complete with foot piece, curb box and lid. Curb box shall be the following or as approved by the Engineer:

| <u>Curb Stop Size</u> | <u>Foot Piece</u> | <u>Curb Box with Lid & Plug</u> |
|-----------------------|-------------------|-------------------------------------|
| ¾" | Mueller H-10391 | Mueller H-10316 |
| 1" | Mueller H-10392 | Mueller H-10316 |
| 1 ½" | Mueller H-10394 | Mueller H-10336 |
| 2" | Mueller H-10395 | Mueller H-10336 |

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 "Execution" and Section 01 77 00 "Closeout Procedures": Requirements for installation examination.
- B. Determine exact location and size of valves and hydrants from Drawings.
- C. Verify that invert elevations are as indicated on Drawings prior to excavation and installation.

3.2 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 16.13 "Trenching".
- B. Clean the interiors of valves and hydrants of foreign matter before installation. Tighten stuffing boxes. Inspect valves and hydrants in opened and closed positions to ensure all parts are in working condition.
- C. VALVES
 - 1. Install valves in conjunction with pipe laying.
 - 2. Set valves and valve boxes plumb. Center valve boxes on the valves or valve operators. Locate valves outside the area of roads and streets where feasible.
 - 3. Provide buried valves with valve boxes installed flush with finished grade.
 - 4. Tamp backfill around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet.

5. Provide valves with tags that reflect the valve number as depicted in the drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 "Quality Requirements": Requirements for inspecting and testing.

Pressure test the system according to AWWA C600 and Section 33 05 05.3

END OF SECTION 33 14 19

SECTION 33 31 13 - SANITARY SEWER

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' documented experience.
- B. Inspection on Delivery: Accept materials on site in manufacturer's original packaging and inspect for damage.
- C. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Store valves in shipping containers with labeling in place.
- D. Protection:
 - 1. Block individual and stockpiled pipe lengths to prevent moving.
 - 2. Provide additional protection according to manufacturer instructions.
- E. Plastic Pipe:
 - 1. Material: Polyvinyl Chloride (PVC).
 - 2. Comply with AWWA C900 , unless otherwise specified.
 - 3. Inside Nominal Diameter: As shown on drawings.
 - 4. End connections: Bell and spigot style, with rubber-ring-sealed gasket joint.
 - 5. Fittings: PVC.
 - 6. Joints:
 - i. Elastomeric Gaskets.
 - ii. Comply with ASTM F477.
- F. HDPE Pipe: HDPE sewer pipe shall meet the requirements of AWWA C906. Pipe shall meet type III, Class B or C, Category 5, and Grade P34 per ASTM D1248.
 - 1. HDPE must have three equally spaced horizontal colored marking stripes. Green stripes shall be used for sanitary sewer pipe.
 - 2. Molded fittings shall be manufactured in accordance with ASTM D3261 and will be so marked. Each production lot of molded fittings will be subjected to the tests required under ASTM D3261.
 - 3. HDPE pipe may be joined by means of flange adapters with back-up rings or mechanical coupling adapters designed for joining polyethylene pipe or for joining polyethylene pipe to another material. Flange and mechanical joint adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. Adapter shall be made from the same resin as the pipe, the sealing surface of the adapters shall be machined with a series of small V-shaped grooves to provide gasketless sealing. Adapters will be rated for full test pressure. For flange adapters, provide a full face neoprene gasket, conforming to ANSI B16.21.
- G. Tracer Wire
 - 1. A green-coated number 12 AWG copper tracer wire shall be installed the entire length of the HDPE and plastic piping.
 - 2. Tracer wire shall be extended into all valve vaults and valve boxes a minimum of 5 feet from each direction.
 - 3. Continuity of tracer wire shall be documented by testing prior to acceptance.
- H. Flexible Couplings
 - 1. Manufacturers:
 - i. Fernco, Inc.

- ii. Approved Equal.
- 2. Description:
 - i. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
 - ii. Attachment: Two stainless-steel clamps, screws, and housings.
- I. Sewer Installation:
 - 1. Install PVC pipe, fittings, and accessories according to ASTM D2321, and seal joints watertight.
 - 2. Install all buried HDPE pipe and fittings in accordance with the manufacturer's recommendations.
 - 3. Any pipe showing a distinct crack with no evidence of incipient fracture beyond the limits of the visible crack, if approved, may have the cracked portion cut off by, and at the expense of, the contractor before the pipe is laid so that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.
 - 4. Cutting of the gravity sewer pipe shall be done in a neat and workmanlike manner without damage to the pipe lining. Unless otherwise authorized by the engineer, all pipe cutting shall be done by means of an approved type of power cutter. The use of hammer and chisel, or any other method with results in rough edges, chipped or damaged pipe, is prohibited.
 - 5. Lay pipe to slope gradients as indicated on drawings.
 - 6. Maximum variation from indicated slope: 1/8 inch in 10 feet.
 - 7. Each pipe section shall be placed into position in the trench in such a manner and by such means required to cause no injury to the pipe, persons, or to any property.
 - 8. Begin at downstream end and progress upstream.
 - 9. Assemble and handle pipe according to manufacturer's instructions, except as may be modified on drawings or by engineer.
 - 10. Keep pipe and fittings clean until work has been completed and accepted by engineer.
 - 11. Furnish slings, straps, and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from storage areas to the trench shall be restricted to operations which can cause no damage to the pipe or lining.
 - 12. The pipe shall not be dropped from trucks onto the ground or into the trench.
 - 13. Damaged pipe coating and/or lining shall be restored and approved by the engineer before installation.
 - 14. Polyethylene wrap: wrap all ductile iron pipe in polyethylene wrap conforming to the requirements of ANSI A21.5.
 - 15. Cap open ends during periods of work stoppage.
 - 16. Lay bell and spigot pipe with bells upstream.
 - 17. Do not displace or damage pipe when compacting.
 - 18. Connect pipe to existing sewer system as shown on drawings.
- J. Request inspection by owner or owner's representative prior to and immediately after placing bedding.

SECTION 40 05 06 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe penetrations.
2. Restrained joints.
3. Flexible connections.
4. Expansion joints.
5. Expansion loops.
6. Sleeve-type couplings.

B. Related Requirements:

1. Section 07 92 00 - Joint Sealants: Sleeve sealant for pipe penetrations.
2. Section 33 01 10 - Disinfecting of Water Utility Piping Systems.
3. Section 33 14 13 - Public Water Utility Piping.
4. Section 33 14 19 - Valves and Hydrants for Water Utility Service.
5. Section 40 05 07 - Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.

1.2 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): The sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.
- B. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.
- C. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

B. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

C. ASME International:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. ASME B31.3 - Process Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX - Welding, Brazing, and Fusing Qualifications.

D. ASTM International:

1. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
2. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
5. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
6. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

E. Expansion Joint Manufacturers Association, Inc.:

1. EJMA Standards.

F. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

G. UL:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 1479 - Fire Tests of Through-Penetration Firestops.
3. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

1.4 COORDINATION

- A. Coordinate Work of this Section with installation of valves and equipment.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit manufacturer catalog information for each specified product.
2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.
3. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
4. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.

C. Shop Drawings:

1. Indicate restrained joint details and materials.
2. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
3. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings for maintenance of fire-resistance rating of adjacent assembly.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1. Provide a certification that all ductile iron products furnished are manufactured in the United States in accordance with Exhibit E of the Contract Documents.

F. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

G. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for:

1. Flexible connectors.
2. Expansion joints.
3. Pipe Restraints:
 - a. Determine restrained lengths and submit joint restraint details.
 - b. Use joint restraint devices specifically designed for applications as described in manufacturer data.
4. Firestopping Engineering Judgments: For conditions not covered by UL- or WH-listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction to accept as meeting fire-protection code requirements.

H. Manufacturer Instructions: Submit special procedures and setting dimensions.

- I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- K. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.
 - 3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 73 00 "Execution" and Section 01 77 00 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping appurtenances.
- C. Identify and describe unexpected variations to pipe routing.

1.7 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
- B. Perform Work according to ASME B31.9 for installation of piping systems and according to AWS D1.1/D1.1M for welding materials and procedures.
- C. Perform Work according to ASME B31.9 and as specified in Section 33 14 13, Public Water Utility Piping for installation of underground piping systems.
- D. Through-Penetration Firestopping of Fire-Rated Assemblies:
 - 1. Comply with ASTM E 814.
 - 2. Minimum Positive Pressure Differential: 0.1-inch wg to achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
 - 3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.
 - 4. Floor and Roof Penetrations:
 - a. Fire F-ratings and Temperature T-ratings: As indicated on Drawings, but not less than one hour.
 - b. Floor Penetrations within Wall Cavities: T-rating is not required.
- E. Through-Penetration Firestopping of Non-fire-rated Floor and Roof Assemblies:
 - 1. Materials to resist free passage of flame and products of combustion.
 - 2. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.

3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- F. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:
1. Comply with ASTM E 1966.
 2. Rating: As indicated on Drawings for assembly in which joint is installed.
- G. Fire-Resistive Joints between Floor Slabs and Exterior Walls:
1. Comply with ASTM E 119.
 2. Minimum Positive Pressure Differential: 0.1-inch wg to achieve fire-resistance rating as indicated on Drawings for floor assembly.
- H. Surface-Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E 84.
- I. Maintain one copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.
- C. Welders: AWS qualified within previous 12 months for employed weld types.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Indiana.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 77 00 "Closeout Procedures": Submittal of Project Warranties.
- B. Furnish five-year manufacturer's warranty for products covered in this Section.

PART 2 - PRODUCTS

2.1 PIPE PENETRATIONS

A. Performance and Design Criteria:

1. Firestopping Materials:
 - a. Comply with ASTM E119 and ASTM E814 to achieve fire ratings as indicated on Drawings for adjacent construction, but not less than one hour.
 - b. Ratings may be three hours for firestopping in through-penetrations of four-hour fire-rated assemblies, unless otherwise required by applicable codes.
2. Firestop interruptions to fire-rated assemblies, materials, and components.
3. Firestopping: Provide certificate of compliance from authority having jurisdiction, indicating approval of materials used.

B. Sleeves:

1. Sleeves for Pipes through Non-fire-rated Floors:
 - a. Material: Galvanized steel.
 - b. Thickness: 18 gage.
2. Sleeves for Pipes through Non-fire-rated Beams, Walls, Footings, and Potentially Wet Floors:
 - a. 18-gage galvanized steel.

3. Sealant:

- a. As specified in Section 07 92 00 - Joint Sealants.

C. Mechanical Sleeve Seals:

1. Manufacturers:

- a. GPT Industries
- b. Approved Equal.

2. Description:

- a. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve.
- b. Connection: Bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.2 RESTRAINED JOINTS

- A. As specified in Section 33 14 13 - Public Water Utility Piping.

2.3 EXPANSION JOINTS

A. Manufacturers:

- 1. Metraflex.
- 2. Proco.
- 3. Or-equal.

B. Performance and Design Criteria:

- 1. Bellow Design: According to Section C of EJMA Standards.
- 2. Flexible pump connectors/expansion joints shall be of the molded twin spherical type reinforced with an external root ring between spheres. Neoprene and nylon construction with internal steel wire, molded within the raised face ends, for added strength. Pressure rated for 225 psi at 240°F, with a minimum 4 to 1 safety factor. Flanges shall be one-piece, free-floating, class 150 galvanized plate steel type with tapped or drilled holes as required. Control Units must be furnished in unanchored applications, or as recommended by the manufacturer. Connectors shall be "Double-sphere" as specified by the manufacturer.

C. Pipe Expansion Joints

1. Provide expansion joints that are of the single arch short type with flanged ends. Fabricate the body of EPDM rubber and reinforced with steel wire for strength. Provide full-pattern flanges drilled to mate with ANSI 125/150 flanges.

2.4 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. Dresser.
2. Or-equal.

B. Description:

1. Comply with AWWA C219.
2. Gaskets:
 - a. Material: EPDM.
 - b. Comply with ASTM D2000.
3. Bolts: Stainless Steel.

C. Finishes:

1. Buried Couplings: Factory epoxy coated.

2.5 INSULATION

- ### A. As indicated on Drawings.

2.6 FINISHES

- ### A. Prepare piping appurtenances for field finishes as specified in Section 09 96 00, High Performance Coatings.

2.7 SOURCE QUALITY CONTROL

- ### A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

1. Provide shop inspection and testing of completed assemblies.

B. Owner Inspection:

1. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
 2. Notify Owner at least seven days before inspections and tests are scheduled.
- D. Certificate of Compliance:
1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution: Examination.
- B. Verify that field dimensions are as indicated on Drawings and Shop Drawings.
- C. Verify that openings are ready to receive sleeves and firestopping.
- D. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.
- E. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

- A. Section 01 73 00 - Execution: Preparation.
- B. Cleaning: Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. Section 01 73 00 - Execution: Installation.
- B. According to ASME B31.9.
- C. Coating: Finish piping appurtenances as specified in Section 09 96 00, High Performance Coatings, for service conditions.
- D. Pipe Penetrations:

1. Sleeves:

- a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
- b. Set sleeves in position in forms and provide reinforcement around sleeves.
- c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
- d. Extend sleeves through floors 1 inch above finished floor level and caulk sleeves.
- e. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent Work with stuffing insulation and caulk airtight.

E. Firestopping:

1. Install material at fire-rated construction perimeters and openings containing penetrating sleeves, piping, and other items requiring firestopping.
2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
3. Apply firestopping material in sufficient thickness and to uniform density and texture to achieve required fire and smoke rating.
4. Placement: Compress fibered material to maximum 40 percent of its uncompressed size.
5. Fire-Rated Surfaces:
 - a. Seal opening at floor, wall, ceiling, and roof.
 - b. Install sleeve through opening and extend beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve, allowing minimum of 1-inch void between sleeve and building element.
 - d. Pack void with backing material.
 - e. Seal ends of sleeve with UL-listed, fire-resistive silicone compound to meet fire rating of structure penetrated.
6. Non-rated Surfaces:
 - a. Seal opening through non-fire-rated floor, wall, ceiling, and roof.
 - b. Install sleeve through opening and extend beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve to allow minimum of 1 inch void between sleeve and building element.
 - d. Install type of firestopping material recommended by manufacturer.
 - e. Occupied Spaces:
 - 1) Where conduit penetrates non-fire-rated surfaces in occupied spaces, Link-Seal penetrations.
 - 2) Occupied spaces include rooms with finished ceilings and rooms where penetration occurs below finished ceiling.

- f. Exterior Wall Openings below Grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place according to manufacturer instructions.
 - g. Interior Partitions:
 - 1) Seal pipe penetrations at laboratories, and electrical rooms.
 - 2) Link-Seal penetration to completely fill annular space between sleeve and conduit.
 - F. Restrained Joints: As specified in Section 33 14 13 "Public Water Utility Distribution Piping".
 - G. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Drawings.
 - H. Expansion Joints:
 - 1. Install flexible couplings and expansion joints at connections to equipment and where indicated on Drawings.
 - 2. If expansion joint is supplied with internal sleeve, indicate flow direction on outside of joint.
 - I. Air Releases: Provide air release valves as indicated on Drawings.
 - J. Insulation: As indicated on Drawings.
 - K. Disinfection: Disinfect potable water piping as specified in Section 33 13 00 - Disinfecting of Water Utility Distribution.
- 3.4 FIELD QUALITY CONTROL
- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
 - B. After installation, inspect for proper supports and interferences.
 - C. Repair damaged coatings with material equal to original coating.
- 3.5 CLEANING
- A. Section 01 77 00 - Closeout Procedures: Final cleaning.
 - B. Keep equipment interior clean as installation progresses.
- END OF SECTION 40 05 06

(NO TEXT ON THIS PAGE)

SECTION 40 05 07 - HANGERS AND SUPPORTS FOR PROCESS PIPING

1.1 SUMMARY

- A. This Section includes requirements for pipe hangers and supports, hanger rods, structural attachments, pipe guides, and formed steel channels.
- B. Related Requirements:
 - 1. Section 03 30 00 – Reinforced Cast-in-Place Concrete
 - 2. Section 09 96 00 - High Performance Coatings.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.9 - Building Services Piping.
- B. ASTM International:
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
 - 4. ASTM A181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code Steel - Reference Manual.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.

1.3 COORDINATION

- A. Coordinate Work of this Section with piping and equipment connections specified in the Drawings and other Sections.

1.4 SUBMITTALS

- A. Section 01 33 00 "Submittal Procedures".

- B. Product Data: Submit manufacturer's catalog data including load capacity.
- C. Shop Drawings: Indicate system layout with location - including critical dimensions, sizes, and pipe hanger and support locations - and detail of trapeze hangers, anchors, and guides.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX AWS D1.1, verifying qualification within previous 12 months.
- F. Delegated Design Submittals:
 - 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - 2. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - 3. Submit sizing methods and calculations sealed by a registered professional engineer.
- G. Manufacturers' Instructions: Submit special procedures and assembly of components.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 77 00 "Closeout Procedures".
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.
- C. Tools: Furnish special wrenches and other devices required for Owner to maintain equipment.

1.6 QUALITY ASSURANCE

- A. Perform Work according to applicable authority (AWS D1.1) for welding hanger and support attachments to building structure.
- B. Perform Work according to local, State and Federal standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum 3 years documented experience.

- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum 3 years documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum 3 years documented experience and approved by Manufacturer.
- D. Licensed Professional: Professional Engineer experienced in design of specified Work and licensed in the State of Indiana.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 "Product Requirements".
- B. Inspection: Accept materials on-site in original factory packaging, labeled with manufacturer's identification.
- C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 "Temporary Facilities and Controls".
- B. Provide ventilation in areas receiving solvent-cured materials.

1.10 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 77 00 "Closeout Procedures".

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Description:
 - 1. Conform to ASME B31.9 and MSS SP58.
 - 2. Provide means of vertical adjustment after erection.
 - 3. Pipe Sizes 1/2 to 1-1/2 in: ASTM A36, steel, adjustable swivel, split ring.
 - 4. Pipe Sizes 2 in and Larger: ASTM A36, steel, adjustable, clevis.

5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 in and Smaller: Cast iron J-hook.
7. Wall Support for Pipe Sizes 4 in and Larger: Welded steel bracket.
8. Vertical Support: Riser clamp.
9. Floor Supports: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

B. Performance and Design Criteria:

1. Pipe Hangers:

- a. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.
- b. Provide linkage to permit lateral or axial movement where anticipated.
- c. Where horizontal pipe movement is greater than 1/2 in, or where hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.

2. Heat Transmission: Design supports, hangers, anchors, and guides to prevent excessive heat from being transmitted to building structure, equipment, or piping appurtenances.
3. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.
4. Point Loads:
 - a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.
 - b. Avoid point loads on plastic piping by providing extra wide pipe saddles or stainless steel shields.

2.2 HANGER RODS

A. Hanger Rods:

1. ASTM A576, steel.
2. All-thread.
3. Diameter: ASME B31.1; as indicated on Drawings.

2.3 STRUCTURAL ATTACHMENTS

A. Concrete Inserts:

1. Description:

- a. Malleable iron case of stainless steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
 - b. Size inserts to suit threaded hanger rods.
- B. Mounting Brackets: ASTM A36, welded steel.
- C. Beam Clamps:
 - 1. ASTM A36, steel; MSS SP-58.
 - 2. Clamp Size: Based on load to be supported and load configuration.
 - 3. Anchoring: Locknuts and cup-point set screws.
 - 4. Reversible top or bottom flange.
- D. Riser Clamps:
 - 1. ASTM A36, steel.
- E. Offset Clamps:
 - 1. Double leg, two-piece.

2.4 PIPE GUIDES

- A. Intermediate Guides:
 - 1. Pipes 6 in and Smaller: Pipe clamp with oversize pipe sleeve.
 - 2. Pipes 8 in and Larger: U-bolts with double nuts.
- B. Alignment Guides:
 - 1. Pipes 8 in and Smaller: Stainless steel type.
 - 2. Pipes 10 in and Larger: Stainless steel type.

2.5 FORMED STEEL CHANNEL

- A. Description:
 - 1. Stainless 12-gage -thick steel.
 - 2. Include holes 1-1/2 in o.c.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field dimensions as indicated on Shop Drawings.

3.2 INSTALLATION

- A. Do not drill or cut structural members.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- C. Pipe Hangers and Supports:
 - 1. Install according to: ASME 31.9 and MSS SP 58.
 - 2. Support horizontal piping as indicated on Drawings.
 - 3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
 - 4. Place hangers within 12 in of each horizontal elbow.
 - 5. Use hangers with 1-1/2 in minimum vertical adjustment.
 - 6. Support horizontal cast iron pipe adjacent to each hub, with 5ft maximum spacing between hangers.
 - 7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 - 8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 - 9. Support riser piping independently of connected horizontal piping.
 - 10. Design hangers for pipe movement without disengagement of supported pipe.
 - 11. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
 - 12. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
 - 13. Use beam clamps where piping is to be suspended from building steel.
 - 14. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
 - 15. Use offset clamps where pipes are indicated as offset from wall surfaces.
 - 16. Do not exceed the following spacings when designing and installing the pipe support systems:
 - 17.

| <u>Type of Pipe and Diameter</u> | <u>Maximum Spacing (ft)</u> |
|----------------------------------|-----------------------------|
| Steel | |
| 10 inch and larger | 20 |
| 8 inch | 18 |
| 6 inch | 16 |
| 4 inch | 14 |
| 2 inch and smaller | 10 |

Ductile Iron or PVC

| | |
|--------------------|----|
| 20 inch and larger | 18 |
| 14 to 18 inch | 16 |
| 10 to 12 inch | 14 |
| 6 to 8 inch | 12 |
| 3 to 4 inch | 10 |
| 2 inch and smaller | 6 |

18. Where piping of various sizes are to be supported together, space supports for smallest pipe size or install immediate supports for the smaller pipe diameter.
19. Provide minimum of two (2) pipe supports for each pipe run.
20. Where piping connects to equipment, support by pipe support and not be equipment, unless approved by equipment manufacturer.
21. Support piping to prevent undue strain on valves, fittings, or equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to nonrigid joints, and where otherwise shown. Do not install pipe supports and hangers in equipment access areas.

D. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.
2. Conform to Section 22 07 19 – Plumbing Piping Insulation.

E. Equipment Bases and Supports:

1. Provide housekeeping pads as detailed on Drawings.
2. Using templates furnished with equipment, install threaded rod anchor bolts and accessories for mounting and anchoring equipment.
3. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed.

F. Prime Coat:

1. Prime coat exposed steel hangers and supports.
2. Conform to Section 09 96 00 “High Performance Coatings”.
3. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

END OF SECTION 40 05 07

(NO TEXT FOR THIS PAGE)

SECTION 40 05 16 – DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing ductile-iron pipe, fittings and appurtenances, except soil pipe.

1. Provide ductile-iron pipe and fittings complete with all necessary jointing facilities and materials, specials, adapters and other appurtenances required for installation in and completion of the pipelines to be constructed.
2. Provide flanged, plain end, rubber gasket, (push-on or mechanical joint), or grooved-type pipe joints of the types, sizes and classes shown or specified.

B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:

1. Section 09 96 00 - High Performance Coatings
2. Section 33 01 10.58 – Utility Directional Drilling
3. Section 33 05 05.31 – Hydrostatic Testing
4. Section 40 05 18 – Miscellaneous Pipes and Fittings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water AWWA C104/A21.4
2. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids AWWA C105/A21.5
3. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings 3 inches through 48 inches, for Water and Other Liquids AWWA C110/A21.10
4. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings AWWA C111/A21.11
5. AWWA C115/A21.15 - Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges AWWA C115/A21.15

6. AWWA C151/A 21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids AWWA C151/A21.51
7. AWWA C153/A21.53 - Ductile-Iron Compact Fittings, 3 inches through 12 inches, for Water and Other Liquids AWWA C153/A21.53
8. AWWA C606 - Grooved and Shouldered Type Joints AWWA C606
9. ASTM A 307 - Specification for Carbon Steel bolts and Studs

1.3 SYSTEM DESCRIPTION

A. Design Standards: Provide ductile-iron pipe meeting the requirements of AWWA C 151/A21.51.

1. Place pipe in structures using a minimum wall thickness of Thickness Class 52 for sizes up to and including 12-inch diameter and Thickness Class 51 for larger sizes, except provide Thickness Class 53 for pipe with threaded flanges or grooved-type joints.
2. Construct concrete encasement where shown.

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Submit the following shop drawings:

1. Pipe joints and fittings, sleeves, cleanouts and couplings. Where special designs or fittings are required, show the Work in large detail and completely describe and dimension all items.
2. Fully dimensioned layout of pipes, fittings, couplings, sleeves, cleanouts, expansion joints, harnessing, valves, supports, anchors and equipment. Label pipe size, materials, type, and class on drawings and include schedule.
3. Cross sections showing elevations of cleanouts, pipes, fittings, couplings, sleeves, valves, supports, anchors and equipment.
4. Catalog data for pipe, fittings, couplings, sleeves, harnessing and cleanouts.

C. Quality Controls: Submit certificates of compliance for pipe, fittings, gaskets, lining, polyethylene encasement, coatings, specials, couplings, sleeves and cleanouts in accordance with this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all pipe, fittings and couplings as specified in Division 1 and Section 40 05 10.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Manufacturers of equivalent product may be submitted.

1. Ductile-iron pipe and fittings.
 - a. American Cast Iron Pipe Company
 - b. McWane Incorporated
 - c. United States Pipe and Foundry
2. Ductile-iron retainer glands.
 - a. 3-inch through 24-inch diameter
 - (1) Nappco, Inc. Series 1246
 - (2) Ebba Iron, Inc., Series 100
 - b. larger than 24-inch diameter
 - (1) Ebba Iron, Inc., Megalug
3. Sleeve-type couplings.
 - a. 12-inches in diameter and smaller
 - (1) Dresser Industries, Style 153
 - (2) Smith-Blair, Type 441 Omni Coupling System
 - b. larger than 12-inches in diameter
 - (1) Dresser Industries, Style 38
 - (2) Smith-Blair, Type 411
 - c. Gaskets.
 - (1) Dresser Plain Grade 27
 - (2) Smith-Blair 003
4. Restrained push-on joints.

- a. U.S. Pipe, TR Flex
- b. McWane Incorporated, Super-Lock
- c. American Cast Iron Pipe Company, Lok-Ring or Flex-Ring

5. Gaskets.

- a. John Crane, Inc.
- b. Garlock Packing Company
- c. U.S. Rubber Company
- d. American Cast Iron Pipe Company
- e. United States Pipe and Foundry
- f. McWane Incorporated

6. Coatings and Linings

- a. Kop-coat
- b. Tnemec
- c. American Cast Iron Pipe Company
- d. United States Pipe and Foundry

7. Grooved-type Couplings.

- a. Victualic

2.2 MATERIALS

A. Fittings:

- 1. General: Provide all fittings meeting the requirements of ANSI A21.10, unless shown or specified otherwise. Fittings 14 inches and larger require a pressure rating of 150 psi, or as specified, whichever is greater.
- 2. Flanged: Where long radius flanged fittings and other flanged fittings not covered in ANSI A21.10 are shown or indicated, provide items meeting the requirements of ANSI A21.10 and having laying lengths conforming to ANSI B16.1 for 125 pound American Standard fittings.
- 3. Nonflange: Where compact mechanical joint or rubber gasket joint fittings are shown or indicated, provide items meeting the requirements of AWWA C153/A21.53.

B. Grooved-Type Coupling Joints

1. General: Groove-type coupling joints consist of elements that remain jointed under pressure with no restraint from buttresses when the pipe is subjected to axial tension.
2. Requirements: Provide groove dimensions, couplings, gaskets, and bolts for grooved-type joints meeting the requirements of AWWA C606.
3. Dimensional Characteristics: Provide pipe for grooved-type coupling joints which has radius cut grooves in accordance with Table 5(5a) of AWWA C606.
 - a. Provide the outside surface of the pipe between the groove and the pipe free from deep pits or swells.
4. Working Pressure: Provide joints where the maximum joint working pressure of the coupling as specified by the manufacturer is not more than the test pressure of the pipeline and is not more than one-third of the ultimate strength of the coupling joint.
5. Unacceptable Joints: Do not accept the following:
 - a. Accept no grooved-type coupling joint unless it can be readily disassembled after it is made up.
 - b. Accept no joints depending on stud bearing or friction to remain tight under tension.

C. Flanged Joints

1. Threaded Flanges: Provide threaded, ductile-iron, long hub flanges meeting the requirements of AWWA C115/A21.15.
 - a. Screw flanges pipe on the threaded end of the pipe in the shop.
 - b. Reface the face of the flange and the end of the pipe together.
 - c. Design the flanges to prevent corrosion of the threads from the outside and to prevent leakage through the pipe threads.
2. Facing and Drilling: Provide flanges faced and drilled to the requirements of AWWA C115/A21.15, unless special drilling is called for or required. Face flange accurately at right angles to the pipe axis. Drill flanges smooth and true, and cover machined faces with zinc dust and tallow or equivalent material.
3. Taps: Tap flanges where tap or stud bolts are required.

4. Fasteners: Provide bolts, stud bolts, and nuts meeting the requirements of ASTM A 307, Grade B.
5. Gaskets: Provide full-face gaskets for flanged joints on 12-inch diameter and smaller pipe and gaskets of the ring type for flanged joints on larger pipe. Provide flange gaskets meeting the requirements of AWWA C115/A21.15 except make gaskets for gas lines with neoprene and aramid.

D. Rubber Gasket Joints

1. Provide mechanical joints and push-on type joints meeting the requirements of AWWA C111/A21.11.

E. Harnessing

1. General: For ductile-iron pipe and fittings with mechanical joints that require harnessing, provide ductile-iron mechanical joint retainer glands.
2. Joint Assemblies: Design the joint assemblies to resist pullout of the joints at the test pressures specified.

F. Wall Pipes and Sleeves

1. Wall Pipes
 - a. Where wall pipes are shown or specified, provide ductile iron wall pipes that meet the requirements of AWWA C110/A21.10 with end connections that are 1) of the types shown and 2) flush with the surfaces of the walls or floors. Unless otherwise shown or specified, provide wall pipes with intermediate collars located at the centers of the walls or floors.
2. Sleeves
 - a. Where pipes pass through exterior walls or floors or wetted interior walls or floors of structures and where wall pipes are not to be provided, provide ductile-iron sleeves meeting the requirements of AWWA C110/A21.10, with ends that are flush with the wall or floor surfaces and with intermediate collars located at the centers of the walls or floors.
 - b. Where pipes pass through non-wetted interior walls or floors and where wall pipes are not to be provided, provide ductile-iron sleeves meeting the requirements of AWWA C110/A21.10; steel pipe sleeves meeting the requirements of Section 40 05 17 or as shown or specified otherwise. Provide sleeves with ends that are flush with the wall or floor surfaces. Where shown

or specified, provide intermediate collars located at the centers of the walls or floors.

- c. Provide sleeves having large enough diameters to accommodate the passage of pipe joints, if required.
- d. Where shown or specified, provide modular, mechanical sleeve seals, meeting the requirements in Section 40 05 18, in the annular spaces between pipes and sleeves. In all other locations, caulk the annular spaces between pipes and sleeves with caulk meeting the requirements in Section 07 90 00.

G. Sleeve-Type Couplings

- 1. General: Manufacture middle rings to the following sizes.
 - a. At least 1/4 inch thick and 5 inches wide for 8-inch diameter and smaller pipe.
 - b. 3/8 inch thick and 7 inches wide for 10- through 30-inch diameter pipe.
 - c. 1/2 inch thick and 10 inches wide for 36-inch diameter and larger pipe.
- 2. Design: Manufacture middle rings without a pipe stop. Provide follower rings of proper thickness. Provide molded rubber gaskets.

H. Cleanouts

- 1. General: Provide cleanouts where shown or specified.
- 2. Size: Provide not less than 6 inch diameter cleanout openings for pipe 8 inches in diameter or larger. Provide cleanout openings for pipe 6 inches in diameter or smaller of the same diameter as the pipe.
- 3. Cleanout Covers: Provide cleanout covers which are blind flanges meeting the requirements of AWWA C110/A21.10, except where conformation is required with the inside curvature of the pipeline, in which case the covers are flanged plugs of proper shape with American Standard flange drilling.
 - a. Fasten covers by means of steel studs and bronze nuts. Drill and tap covers for a 1-1/2-inch diameter pipe connection.
- 4. Plugs: Equip the flange of conformed plugs with a dowel or other suitable means to provide proper setting.

I. Connecting Pieces, and Special Fittings

1. Connecting Pieces: Provide connecting pieces, such as bell and bell, bell and spigot, bell and flange, flange and flange, flange and spigot, and flange and flare, meeting the requirements of AWWA C110/A21.10.
 2. Special Fittings : Provide special fittings, where required, of an approved design that have the same diameters and thicknesses as standard fittings, unless otherwise required, but their laying lengths and other functional dimensions are determined by their positions in the pipeline and by the particular piping materials to which they connect.
- J. Temporary Bulkheads: Provide temporary bulkheads at the ends of pipeline sections where adjoining pipelines have not been completed and are not ready to connect.
1. Removal: Remove all temporary bulkheads when they are no longer needed.
- K. Coatings and Linings
1. Cement Lining: Provide all ductile-iron pipe and fittings having a cement-mortar lining not less than standard thickness meeting the requirements of ANSI A21.4, unless shown or specified otherwise.
 2. Exterior Primer: Shop coat ductile-iron pipe and fittings on the outside with one coat of Kop-Coat 340 Gold Primer, 2.0 mils minimum dry thickness, for use in exposed locations, such as inside buildings, where finish painting or insulating is required.
 3. Asphaltic Coating: Coat pipe for use not exposed to view with the standard asphaltic outside coating specified in AWWA C151/A21.51.
 4. Encased Pipe: Do not coat or paint the outside of fittings and pipe which are to be encased in concrete where watertightness is to be obtained.
 5. Labels: Paint the weight and class designation conspicuously in white on the outside of each pipe, fitting, and special casting after the shop coat has hardened.
 6. Grooved-type Couplings: Shop coat couplings with Kop-Coat 340 Gold Primer, 2.0 mils minimum dry thickness.
 7. Flange Joints: Immediately after facing and drilling, coat the back of the flanges and bolt holes with asphaltic coating meeting the requirements of AWWA C151/A21.51, Section 51-8.1.
 8. Sleeve-type Couplings:
 - a. Shop coat couplings with Dresser Industries Red D or Smith-Blair Standard Blue shop coat.

- b. Provide an additional shop coat of Kop-Coat Hi-Guard epoxy or Tnemec Potapox on the interior of the middle ring.
 - c. Finish coat exterior of sleeve-type coupling after installation with the same coating specified in Section 09 96 00 for the pipeline of which it is a part.
 - d. Ensure shop coats and finish coats are compatible.
- L. Drip Pans: Provide drip pans constructed of 16-gauge Type 304 stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install all ductile-iron pipe and fittings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1 and Section 40 05 10.
- B. Insulation: Where shown or specified provide insulation, as specified in Section 40 42 00, for pipes and fittings that are exposed to atmosphere after installation.
- C. Drip Pans: Provide drip pans under all ductile-iron pipelines installed over electrical equipment and motors and properly connect to the drainage system with 3/4-inch red brass pipe. Make leak tight connection between the drip pan and the drain pipe. Pitch pans uniformly toward the drain pipe not less than 1/8-inch per lineal foot.

LEAKAGE TESTING

- D. Cleaning: Flush clean and test all pipes after installation.
- E. Testing: Test pipes for leaks and repair or tighten as required.
- F. Procedures: Conduct tests in accordance with Section 01 45 50.

3.2 DISINFECTION

- A. Disinfect all pipelines that are to carry potable water before they are placed into service as specified in Section 33 13 00.

3.3 SCHEDULES

- A. Schedule of materials to be specified herein and on the contract drawings.

END OF SECTION 40 05 16

(NO TEXT ON THIS PAGE)

SECTION 40 05 18 – MISCELLANEOUS PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing miscellaneous pipe and fittings as indicated. Miscellaneous pipe and fittings include all aluminum, copper, brass, plastic, cast-iron soil and lined steel pipe and fittings.

B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:

1. Section 09 96 00 - High Performance Coatings
2. Section 33 01 10.58 – Disinfection of Water Utility Piping Systems
3. Section 33 05 05.31 – Hydrostatic Testing
4. Section 33 05 07.13 Utility Directional Drilling
5. Section 33 14 13 – Public Water Utility Piping
6. Section 33 14 19 – Valves and Hydrants for Water Utility Service
7. Section 40 05 10 - Erecting and Jointing Interior Piping
8. Section 40 05 16 - Ductile Iron Pipe and Fittings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 74 - Specification for Cast Iron Soil Pipe and Fittings
2. ASTM B 26/B26M - Aluminum Alloy Sand Castings
3. ASTM B 32 - Specification for Solder Metal
4. ASTM B 42 - Specification for Seamless Copper Pipe, Standard Sizes
5. ASTM B 43 - Specification for Seamless Red Brass Pipe, Standard Sizes
6. ASTM B 108 - Specification for Aluminum Alloy Permanent Mold Castings

- | | | |
|-----|--------------|--|
| 7. | ASTM B 241 | - Specification for Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube |
| 8. | ASTM C 564 | - Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| 9. | ASTM D 1784 | - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds |
| 10. | ASTM D 1785 | - Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| 11. | ASTM D 2464 | - Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| 12. | ASTM D 2564 | - Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems |
| 13. | ASTM D 2855 | - Recommended Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings |
| 14. | ASTM F 491 | - Specification for Poly (Vinylidene Fluoride) (PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings |
| 15. | ASTM F 492 | - Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings |
| 16. | ASTM F 599 | - Specification for Poly (Vinylidene Chloride) (PVDC) Plastic-Lined Ferrous Metal Pipe and Fittings |
| 17. | ASME B1.20.1 | - Screw Threads - Pipe Threads, General Purpose (Inch) |
| 18. | ASME B16.15 | - Cast Bronze Threaded Fittings, Classes 125 and 250 (Includes Revisions Service) |
| 19. | ASME B16.18 | - Cast Copper Alloy Solder Joint Pressure Fittings (Includes Revision Service) |

- 20. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fitting (Includes Revision Service)
- 21. ASME - Boiler and Pressure Vessel Codes, Section IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- 22. AWWA C151/A21.51 - Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- 23. CISPI 301 - Hubless Cast Iron Sanitary System
- 24. CISPI 310 - Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- 25. AWS A5.8 - Brazing Filler Metal

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Shop Drawings: Submit the following Shop Drawings.
 - 1. Submit complete detailed shop drawings in conformance with the specified requirements.
 - 2. Include drawings that show the piping layouts and schedules of all pipe, fittings, valves, expansion joints, flexible couplings, hangers, supports and other appurtenances.
 - 3. When any work is of special design show in large detail and completely describe and dimension.
 - 4. Welders Certificate: Include welders' certification with ASME/Section IX.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Pipe and Fittings:

a. Aluminum Pipe and Fittings

- (1) ALCOA, Pittsburgh, PA
- (2) ALCAN Aluminum Corp., Cleveland, OH

b. Brass Pipe and Fittings

- (1) Metalloy Industries, Inc., Ft. Lauderdale, FL
- (2) Nibco, Elkhart, IN

c. Cast-Iron Soil Pipe and Fittings

- (1) U.S. Pipe and Foundry Co., Birmingham, AL
- (2) Tyler Pipe Industries, Tyler, TX
- (3) Charlotte Pipe and Foundry, Charlotte, NC

d. Copper pipe and Fittings

- (1) Mueller Industries, Inc., Wichita, KS
- (2) Nibco, Elkhart, IN

e. PVC and CPVC Pipe and Fittings

- (1) United States Plastic Corp., Lima, Ohio
- (2) Harvel Plastics Inc., Easton, Pennsylvania

f. Lined Steel Pipe and Fittings

- (1) Polyvinylidene Chloride (PVDC) lined pipe and fittings
 - (a) Ameriform Manufacturing, Inc., Milton, KY
- (2) Polypropylene-lined pipe and fittings
 - (a) Performance Plastics Products, Houston, TX

(b) Crane Resistoflex Co., Bay City, MI

(3) Polyvinylidene fluoride (PVDF or Kynar®) lined pipe and fittings

(a) Performance Plastics Products, Houston, TX

(b) Crane Resistoflex Co., Bay City, MI

g. Wall Sleeve Annular Seals

(1) Thunderline Corp. (Link-Seal), Belleville, MI

2. Dielectric Insulating Fittings:

a. Walter Vallett Co., Detroit, MI

b. EPCO, Inc., Cleveland, OH

2.2 MATERIALS

A. Aluminum Pipe and Fittings

1. Pipe: Provide aluminum pipe of Alloy 6061 and T6 temper conforming to ASTM B 241.

2. Welding and Threaded Fittings: Provide aluminum forged welding fittings or cast threaded fittings conforming to ASTM B 26/B26M or B 108.

3. Flanged and Coupling Connections: Provide joints that are made with aluminum mechanical couplings in combination with grooved, flared or plain end pipe or that are flanged.

a. When grooved couplings are used, roll the grooves into the pipe in conformance with the coupling manufacturers specifications.

b. Do not use cut grooves.

4. Lubricating Compound: Carefully assemble fittings and couplings with an approved lubricating compound to prevent seizing of the connection and overstressing of the pipe.

a. Provide a lubrication compound which both lubricates and seals, for pipelines subject to internal pressure.

5. Supports: Use aluminum, hot-dipped galvanized steel or other approved type.

B. Brass Pipe and Fittings

1. Pipe: Provide red brass pipe that meets the requirements of ASTM B 43.
 - a. Provide pipe sizes, wall thicknesses and dimensions that meet the ASTM B 43 Table 2 requirements for regular pipe.
 2. Fittings: Provide brass pipe fittings that meet the ASME B16.15 requirements.
 - a. Provide fittings rated for steam working pressures up to 125 psig.
 - b. Provide unions made entirely of brass or bronze.
 - c. Provide screwed type joints with clean cut, tapered and smooth threads that meet ASME B1.20.1 requirements.
3. Finish: Provide piping with a rough finish, unless otherwise specified.

C. Cast-Iron Soil Pipe and Fittings

1. Pipe and Fittings: Provide service weight, hub and spigot, cast-iron soil pipe and fittings meeting the requirements of ASTM A 74 or hubless cast iron soil pipe and fittings meeting the requirements of CISPI 301. Do not use hubless pipe and joints for buried pipe.
2. Protective Coatings: Provide interior protective coatings (linings) and exterior protective coatings for pipe and fittings in the finished work as follows and as indicated in the piping schedules:
 - a. For pipe and fittings not exposed in the finished work, provide an interior bituminous lining and an exterior bituminous coating that meet AWWA C151/A21.51 requirements.
 - b. For pipe and fittings exposed in the finished work, provide an interior bituminous lining that meets AWWA C151/A21.51 requirements.
 - (1) If the pipe schedules indicate that the pipe exterior is to be painted, paint in accordance with the requirements in Section 09 96 00.

- (2) If the pipe schedules indicate that the pipe exterior is to have a bituminous coating, coat the pipe in accordance with the requirements in AWWA C151/A21.51.

3. Joints: Provide lead and oakum joints or neoprene gasket, compression type joints in accordance with ASTM C 564 for hub and spigot pipe. Consult the piping schedules. Provide hubless couplings for hubless pipe. Compose hubless couplings of a stainless steel shield, clamp assembly and an elastomeric sealing sleeve conforming to CISPI 310.
4. Cleanouts: Provide cleanouts where shown or specified, and meeting the requirements of Section 22 10 00, unless otherwise specified.

D. Copper Pipe and Fittings

1. Small Copper Piping: For copper pipe 3 inches in diameter and smaller, provide Type K hard drawn copper tubing that meets ASTM B 88 requirements.
 - a. Fittings: Provide ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and copper alloy fittings.
 - b. Joints: Threaded or ASTM B 32 lead-free soldered joints.
 - c. Joints: Brazed joints, AWS A5.8 BCUP silver/phosphorus/copper alloy with melting range 1190-1480 degrees F.
2. Large Copper Piping: For copper pipe larger than 3 inches in diameter, provide regular seamless copper pipe that meets the ASTM B 42 requirements.
 - a. Fittings: Provide solder type fittings of the same material as the pipe.
 - b. Joints: Use threaded or brazed joints.
3. Potable Water Piping: Use ASTM B 32 alloy Grade 95TA (95 percent tin and 5 percent antimony) solder for piping carrying potable water.
4. Unacceptable Uses: Do not use copper pipe with soldered joints for transporting fuel oil or other flammable or toxic liquids inside buildings.

E. Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings

1. Pipe and Fittings: Provide PVC pipe and fittings that are Schedule 80 and meet the requirements of ASTM D 1784 Class 12454-B and ASTM D 1785 unless otherwise shown or specified. Provide CPVC pipe and fittings that are Schedule 80 and meet the requirements of ASTM D 1784 Class 23447-B and ASTM D 1785, unless otherwise shown.
2. Joints: Provide ASTM D 2855 solvent welded joints utilizing ASTM D 2564 solvent cement or ASTM D 2464 threaded joints, as indicated in the piping schedules.

F. Lined Steel Piping

1. Polyvinylidene Chloride (PVDC) Lined: Provide PVDC lined steel pipe and fittings meeting the requirements of ASTM F 599, except provide PVDC liner that has a minimum elongation at yield of 5 percent.
2. Polypropylene Lined: Provide Type I polypropylene lined steel pipe and fittings meeting the requirements of ASTM F 492.
3. Polyvinylidene Fluoride (PVDF) Lined: Provide PVDF lined steel pipe and fittings meeting the requirements of ASTM F 491.

G. Wall Pipes and Sleeves for Miscellaneous Pipe and Fittings

1. Wall Pipes

a. Where wall pipes are shown or specified, provide ductile iron wall pipes that meet the requirements of AWWA C110/A21.10 with end connections that are 1) of the types shown and 2) flush with the surfaces of the walls or floors. Unless otherwise shown or specified, provide wall pipes with intermediate collars located at the centers of the walls or floors.

2. Sleeves

a. Where pipes pass through exterior walls or floors or wetted interior walls or floors of structures and where wall pipes are not to be provided, provide ductile-iron sleeves meeting the requirements of AWWA C110/A21.10 with ends that are flush with the wall or floor surfaces and with intermediate collars located at the centers of the walls or floors.

b. Where pipes pass through non-wetted interior walls or floors and where wall pipes are not to be provided, provide ductile-iron sleeves meeting the requirements of AWWA C110/A21.10; steel pipe sleeves meeting the requirements of Section 40 05 17 or as shown or specified otherwise. Provide sleeves with ends flush with the wall or floor surfaces.

Where shown or specified, provide intermediate collars located at the centers of the walls or floors.

c. Provide sleeves having large enough diameters to accommodate the passage of pipe joints, if required.

d. HDPE Sleeves: Where shown or specified, provide molded HDPE sleeves as manufactured by the Thunderline Corporation, or approved equal, with integrally formed intermediate collars or waterstops.

e. Where shown or specified, provide modular, mechanical sleeve seals, meeting the requirements of this Section, in the annular spaces between pipes and sleeves. In all other locations, caulk the annular spaces between pipes and sleeves with caulk meeting the requirements in Section 07 90 00.

H. Modular, Mechanical Sleeve Seals: Provide modular, mechanical type seals consisting of interlocking, synthetic-rubber links shaped to continuously fill the annular space between the pipe and the sleeve. Provide an elastomeric sealing element that is of the size, quantity, type and material that the manufacturer recommends for the intended service and that will provide an effective hydraulic seal. Provide stainless steel bolts and nuts.

I. Supports and Anchors: Provide all pipelines with supporting and anchoring devices as specified in Section 40 05 01. Provide drip pan hangers and supports as specified for sheet metal ductwork in Section 23 31 00.

J. Drip Pans: Provide drip pans constructed of 16-gauge Type 304 stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install all miscellaneous pipe and fittings in accordance with the specifications contained herein and in Sections 33 05 50 and 40 05 10 and in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

B. Connections Between Dissimilar Metals: Where connections are to be made between pipelines or equipment of corrosion causing dissimilar metals make the connections using dielectric insulating couplings, unions or other approved dielectric insulating devices.

C. Couplings: Only use couplings to join standard lengths of pipe and as required to complete a straight run of pipe. Do not use couplings to join random lengths of pipe and cuttings from standard lengths.

D. Reducing Fittings: Use reducing fittings for all changes in pipe size. Do not use bushings.

E. Pipe Flexibility: Make ample provisions for flexibility in all pipelines in accordance with Section 33 05 50 for buried pipelines and Section 40 05 10 for interior pipelines.

F. Drip Pans: Provide drip pans under all metallic pipelines installed over electrical equipment and motors and properly connect to the drainage system with 3/4-inch red brass pipe. Make leaktight connection between the drip pan and the drain pipe. Pitch pans uniformly toward the drain pipe not less than 1/8-inch per lineal foot.

3.2 CLEANING AND PAINTING

A. Cleaning: Flush all process and potable water pipelines with clean water.

B. Leakage: Test pipes at the pressures specified in the piping schedules located in Section 33 05 50 and Section 40 05 10.

C. Paint in accordance with Section 09 96 00, unless otherwise specified.

3.3 DISINFECTION

A. Disinfect all potable water pipelines in accordance with Section 33 13 00.

3.4 SCHEDULES

A. Refer to the schedules contained in Section 33 05 50 Laying and Jointing Buried Pipelines and Section 40 05 10 Erecting and Jointing Interior Piping for information on the piping that is to be constructed using the pipe materials and methods specified herein.

END OF SECTION 40 05 18

SECTION 40 05 19 – HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing buried High Density Polyethylene (HDPE) pipe, fittings and appurtenances.

1. Provide HDPE pipe and fittings complete with all necessary jointing facilities and materials, specials, adapters and other appurtenances required for installation in and completion of the pipelines to be constructed.

B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:

1. Section 01 45 50 - Leakage Test
2. Section 09 96 00 - High Performance Coatings
3. Section 31 23 16 - Excavation
4. Section 31 23 23 - Backfilling
5. Section 33 05 50 - Laying and Jointing Buried Pipelines
6. Section 33 13 00 - Disinfection

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D1238 - Test method for Flow Rates Thermoplastics by Extrusion Plastometer
2. ASTM D1248 - Specification for Polyethylene Plastic Molding and Extrusion Materials
3. ASTM D1505 - Test Method for Density of Plastics by the Density-Gradient Technique
4. ASTM D1599 - Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
5. ASTM D1603 - Test Method for Carbon Black in Olefin Plastics
6. ASTM D2122 - Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

7. ASTM D2290 - Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe by Split Disk Method
8. ASTM D2657 - Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
9. ASTM D2837 - Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
10. ASTM D 3261 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
11. ASTM D3350 - Specification for Polyethylene Plastics Pipe and Fittings Materials
12. ASTM F714 - Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
13. AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances
14. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4-in. Through 63-in, for Water Distribution
15. ANSI B16.1 - Cast Iron Flanges and Flanged Fittings
16. ANSI B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
17. Plastics Pipe Institute TR-4 - Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds

1.3 SYSTEM DESCRIPTION

A. Design Standards: Provide HDPE pipe and fittings meeting the requirements of AWWA C906.

1. Provide HDPE pipe and fittings of various sizes as specified in the schedule or shown. HDPE pipe and fittings will be DR-11.

1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Submit the following shop drawings:
1. Pipe joints, fittings, sleeves and couplings. Where special designs or fittings are required, show the Work in large detail and completely describe and dimension all items.
 2. Fully dimensioned drawings of piping layouts, including fittings, couplings, sleeves, cleanouts, valves, supports and anchors. Label pipe size, materials, type, and class on drawings and include the limits of each reach of restrained joints. Provide cross sections showing elevations of cleanouts, pipes, fittings, sleeves, and valves.
 3. Catalog data for pipe, couplings, sleeves, gaskets and tape coating system.
 4. Installation method, adapter system and the proposed method and specialized equipment to be used.
- C. Quality Control: Submit certificate of compliance for pipe, fittings, gaskets, linings, specials, couplings and sleeves in accordance with this Section.
1. Submit evidence of Contractor's experience jointing HDPE.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 1, Section 33 05 50 and as follows:
1. When lifting with slings, only wide fabric choker slings will be used to lift, move, or lower pipe and fittings. Wire rope or chain will not be used. Slings will be of sufficient capacity for the load, and will be inspected before use. Worn or defective equipment will not be used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Manufacturers of equivalent products may be submitted. All HDPE pipe and fittings will be provided by a single manufacturer.

1. HDPE Pipe and Fittings:
 - a. Chevron Phillips Chemical Company LP, Performance Pipe
 - b. PolyPipe, Inc.
2. Fusion Datalogger
 - a. McElroy Manufacturing, Inc.

2.2 MATERIALS

- A. Pipe and Fittings: Materials used for the manufacture of HDPE pipe and fittings will be PE3408 HDPE meeting cell classification PE345464C per ASTM D3350. Pipe and fittings will meet AWWA C906 standards. Material will be listed in the name of the pipe and fitting manufacturer in Plastics Pipe Institute TR-4 with a standard grade rating of 800 psi at 73°F. Pipe will meet Type III, Class B or C, Category 5, and Grade P34 per ASTM D1248.
- B. Color Identification: HDPE must have at least three equally spaced horizontal colored marking stripes. The pipe will be color coded for the intended use. Blue stripes will be used for city water pipe, yellow stripes will be used for effluent water pipe, brown stripes for sludge pipe, and green stripes for sanitary sewer pipe.
- C. Molded Fittings: Molded fittings will be manufactured in accordance with ASTM D3261 and will be so marked. Each production lot of molded fittings will be subjected to the tests required under ASTM D3261.
- D. Fabricated Fittings: Fabricated fittings will be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings will be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Butt fusion outlets will be made to the same outside diameter, wall thickness, and tolerances as the mating pipe.
- E. HDPE Adapters: HDPE pipe may be joined by means of flange adapters with back-up rings or mechanical coupling adapters designed for joining polyethylene pipe or for joining polyethylene pipe to another material. Flange and mechanical joint adapters will be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. Adapters will be made from the same resin as the pipe. The sealing surface of the adapters will be machined with a series of small v-shaped grooves to provide gasketless sealing. Adapters will be rated for full test pressure, full bulkhead force. For flange adapters, provide a full face neoprene gasket, conforming to ANSI B16.21.
- F. Back-up Rings, Flange Bolts, Gland Rings and Stiffeners: Flange adapters will be fitted with ductile iron back-up rings pressure rated equal to or greater than the mating pipe. The ductile iron back-up ring bore will be chamfered or radiused to provide clearance

to the flange adapter radius. Flange bolts and nuts will be type 304 stainless steel SAE Grade 3 or higher. Mechanical coupling adapters will be fitted with ductile iron gland rings. For flange and mechanical joints, provide stainless steel pipe stiffeners in accordance with the manufacturer's recommendations.

2.3 MANUFACTURER'S QUALITY CONTROL

A. The pipe and fitting manufacturers will have an established quality control program responsible for inspecting incoming and outgoing materials and assuring the quality of the pipe and fittings required by these specifications. The Manufacturer's production facilities will be open for inspection by the DISTRICT or his authorized representative. Qualified manufacturers will be approved by the DISTRICT. Incoming polyethylene materials will be inspected for density, melt flow rate, and contamination. The cell classification properties of the material will be certified by the supplier, and verified by Manufacturer's Quality Control. Incoming materials will be approved by Quality Control before processing into finished goods. Outgoing materials will be checked for:

- Outside diameter, wall thickness, and eccentricity as per ASTM D2122 at a frequency of at least once/hour or once/coil, whichever is less frequent.
- Straightness, inside and outside surface finish, markings and end cuts will be visually inspected as per ASTM F714 on every length of pipe.

Quality Control will verify production checks and test for:

- Density as per ASTM D1505 at a frequency of at least once per extrusion lot.
- Melt Index as per ASTM D1238 at a frequency of at least once per extrusion lot.
- Carbon content as per ASTM D1603 at a frequency of at least once per day per extrusion line.
- Quick burst pressure sizes thru 4-inch as per ASTM D1599 at a frequency of at least once per day per line.
- Ring Tensile Strength sizes above 4-inch equipment permitting as per ASTM D2290 at a frequency of at least once per day per line.

X-ray inspection will be used to inspect molded fittings for voids, and knit line strength will be tested. All fabricated fittings will be inspected for joint quality and alignment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all buried HDPE pipe and fittings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1 and Section 33 05 50.

3.2 TRACER WIRE

A. A green-coated number 12 AWG copper tracer wire will be installed the entire length of the HDPE pipelines. The tracer wire will be accessible from the surface at intervals not to exceed 500 feet.

B. The tracer wire will be extended into all valve vaults and valve boxes (pump station valve vault, air release vault, clean-out valves, etc.) a minimum of 5 feet, from each direction. If valve vault/valve box spacing exceeds 500 feet, then tracer wire access test box shall be provided as necessary. The tracer wire access test box will be constructed as per the typical details. The wire will be neatly rolled and placed on a stainless steel hook so that it does not interfere with normal operation.

C. Continuity of tracer wire will be documented by testing prior to acceptance.

3.3 TESTING

A. Butt Fusion Testing: On every day butt fusions are to be made, the first fusion of the day will be a trial fusion. The trial fusion will be allowed to cool completely, then fusion test straps will be cut out. The test strap will be 12 inches (min) or 30 times the wall thickness in length with the fusion in the center, and 1 inch (min) or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion will be made, cooled completely, and tested. Butt fusion of pipe to be installed will not commence until a trial fusion has passed the bent strap test.

1. Perform all butt fusion joints in the presence of the ENGINEER or his representative. All butt welded HDPE joints and pre-fabricated fittings will be made with the assistance of a datalogger. Each butt-welded joint will have an identification number. The number will be recorded on the pipe joint itself. The joint number along with all critical fusion information, including temperature and fusion pressure, will be recorded on the datalogger. At the completion of the project, supply a copy of the fusion information, for all field welded joints, to the ENGINEER. The datalogger used will be capable of field printed reports and capable of providing the field operator a graphical representation of the previously completed joint.

2. All butt fusion joints will be subject to a visual inspection in accordance with the HDPE pipe manufacturer's guidelines. All joints which do not meet the requirements for the visual inspection will be replaced by new joints.

B. Hydrostatic Pressure Testing: HDPE pipes will be pressure tested in accordance with Section 01 45 50.

3.4 DISINFECTION

A. Disinfect all pipelines that are to carry potable water before they are placed into service as specified in Section 33 13 00.

3.5 SCHEDULES

A. Refer to the schedule contained in Section 33 05 50 Laying and Jointing Buried Pipelines for information on the piping that is to be constructed using the pipe materials and methods specified herein.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 40 05 20 – VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for furnishing and installing all valves and operators, except special regulating valves, telescopic valves, flap valves and valves specified in Section 22 10 00 - Plumbing Piping and Valves.

1. Where valve operators are installed in NEC Class I, Group D, Division 1 or 2 hazardous locations (as specified), provide operator-related electrical equipment and appurtenances that are UL, Inc. approved for use in such areas.

2. Provide valve operators complete, including a suitable enclosure, with all appurtenances necessary for the operator to perform its intended function. Such appurtenances include, but are not limited to, anchor bolts and other mounting hardware, control switches, limit switches, pressure switches, torque switches, gauges, control valves, electrical supply connections, internal electric wiring and controls, terminal blocks, air supply piping, solenoid valves, miscellaneous valves, regulating controls, push button controls, miscellaneous controls, extension stems, local and remote indicators, operating nuts, purge water service with all associated piping, indicating lights, floor boxes, direct burial valve boxes and other such items.

3. For each valve, provide the type of operator specified for the valve in the Valve Schedule.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 05 05 13 - Galvanizing
2. Section 09 96 00 - High Performance Coatings
3. Section 26 05 19 - Wires and Cables - 600 Volts and Below
4. Section 26 05 60 - Electrical Requirements for Shop-Assembled Equipment
5. Section 26 05 80 - Electric Motors
6. Section 40 05 18 - Miscellaneous Pipe and Fittings
7. Section 40 05 21 - Telescopic Valves

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASME B1.20.1 - Pipe Threads, General Purpose

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| 2. | ASME B1.20.7 | - Hose Coupling Screw Treads |
| 3. | ASME B16.1 | - Cast Iron Pipe Flanges and Flanged Fittings |
| 4. | ASTM A 27/A27M | - Specification for Steel Castings, Carbon, for General Application |
| 5. | ASTM A 29/A29M | - Specification for Steel Bars, Carbon and Alloy, Hot Wrought and Cold-Finished, General Requirements |
| 6. | ASTM A 48 | - Specifications for Gray Cast Iron Castings |
| 7. | ASTM A 126 | - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| 8. | ASTM A 197 | - Specification for Cupola Malleable Iron |
| 9. | ASTM A 276 | - Specification for Stainless and Heat-Resisting Steel Bars and Shapes |
| 10. | ASTM A 278 | - Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 F |
| 11. | ASTM A 395 | - Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures |
| 12. | ASTM A 436 | - Specification for Austenitic Gray Iron Castings |
| 13. | ASTM A 479/A479M | - Specification for Stainless and Heat Resisting Steel Wire Bars, and Shapes for Use in Boilers and Other Pressure Vessels |
| 14. | ASTM A 536 | - Specification for Ductile Iron Castings |
| 15. | ASTM A 564/A564M | - Hot Rolled and Cold Finished Age Hardening Stainless and Heat Resisting Steel Bars and Shapes |
| 16. | ASTM A 572/A572M | - Specification for High Strength Low Alloy Columbium Vanadium Steels of Structural Quality |

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|-----|------------------|---|
| 17. | ASTM A 743/A743M | - Specifications for Castings, Iron-Chromium, Iron-Chromium - Nickel, and Nickel-Base Corrosion-Resistant for General Application |
| 18. | ASTM A 744/A744M | - Specification for Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service |
| 19. | ASTM B 30 | - Specification for Copper Base Alloys in Ingot Form |
| 20. | ASTM B 62 | - Specification for Composition Bronze or Ounce Metal Castings |
| 21. | ASTM B 148 | - Specification for Aluminum-Bronze Castings |
| 22. | ASTM B 584 | - Specification for Copper Alloy Sand Castings for General Applications |
| 23. | AWWA C500 | - Metal Seated Gate Valves for Water and Sewerage Systems |
| 24. | AWWA C502 | - Dry-Barrel Fire Hydrants |
| 25. | AWWA C504 | - Rubber-Seated Butterfly Valves |
| 26. | AWWA C508 | - Swing Check Valves for Waterworks Service, 2 inch through 24 inch NPS |
| 27. | AWWA C509 | - Resilient-Seated Gate Valves for Water Supply Service |
| 28. | AWWA C540 | - Power-Actuating Devices for Valves and Sluice Gates |
| 29. | MSS SP-70 | - Cast Iron Gate Valves, Flanged and Threaded Ends |
| 30. | MSS SP-71 | - Cast Iron Swing Check Valves, Flanged and Threaded Ends |
| 31. | MSS SP-80 | - Bronze, Globe, Angle and Check Valves |
| 32. | NACM - | Welded and Weldless Chain Specifications |

- 33. SAE J356 - Welded Flash Controlled Low-Carbon Steel Tubing Normalized for Bending, Double Flaring, and Beading
- 34. SAE J524 - Seamless Low-Carbon Steel Tubing Annealed for Bending and Flaring
- 35. SAE J525 - Welded and Cold-Drawn Low-Carbon Steel Tubing Annealed for Bending and Flaring

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Shop Drawings: Submit the following:
 - 1. Complete detailed drawings of all valves
 - 2. Working drawings, including arrangement and erection drawings of the operators and control equipment; schematic control diagrams, electrical connection diagrams, and complete description of the control system; and operating characteristics
 - 3. Certified shop test report for the hydraulic power unit.
- C. Quality Control Submittals: Submit the following:
 - 1. If requested, manufacturer's certified performance and material records.
 - 2. If requested, complete calculations for each size of motor operator indicating the force required to operate the valve, the operator force provided, full load and locked rotor current, and horsepower.
- D. Operation and Maintenance: Submit operation and maintenance manuals for the valve operators.

1.4 QUALITY ASSURANCE

- A. Furnish all valves of the same type from the same manufacturer. Provide parts that are interchangeable for all valves of the same type and size.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products as specified in Division 1 and as follows.

B. Historical Performance: Furnish and install eccentric plug valves of a type that has shown successful performance for a minimum of ten years. If requested, submit documentation of successful installations in which eccentric plug valves of the proposed type have been in operation for at least ten years.

C. Tests: Furnish a letter confirming that all plug valves have been satisfactorily tested as specified, prior to shipment.

D. Storage and Erection: Pack and store all valves in satisfactory operating condition. Carefully erect all valves in their respective positions, free from all distortion and strain.

1.6 SPARE PARTS

A. For each size cylinder:

1. One set of packing
2. One set of cup leathers or O-rings
3. One needle valve (if used)
4. One check valve (if used)
5. One oil fog unit (if used)
6. One hose (for swiveling type cylinders)
7. One solenoid control valve

B. For electric motor operators:

1. One motor of each size
2. One torque switch of each size
3. One limit switch assembly of each size
4. Six push buttons
5. Six color caps of each color
6. Twenty indicating lamps
7. One reversing starter of each size
8. One overload relay of each size

PART 2 PRODUCT

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Gate Valves:
 - a. American Flow Control
 - b. M&H Valve Company
 - c. Mueller Company
 - d. NIBCO, Inc.
 - e. Stockham
 - f. United States Pipe and Foundry
2. AWWA Butterfly Valves:
 - a. American Flow Control
 - b. DeZurik
 - c. Keystone
 - d. Pratt
3. Eccentric Plug Valves:
 - a. DeZurik
4. Lubricated Plug Valves:
 - a. Crane (2 inches in diameter and smaller)
 - b. DeZurik (2 inches in diameter and smaller)
 - c. Homestead (2-1/2 inches in diameter and larger)
 - d. Rockwell (2-1/2 inches in diameter and larger)
 - e. Walworth (2-1/2 inches in diameter and larger)
5. Single Disc Swing Check Valves:
 - a. American Flow Control
 - b. Clow Valve Company
 - c. M&H Valve Company
 - d. Mueller Company
6. Double Disc Check Valve:
 - a. Crane Stockham Valve Ltd.
 - b. APCO
7. Solenoid:
 - a. Automatic Switch Company
 - b. Magnetrol

8. Globe and Angle Valves:
 - a. NIBCO, Inc.
 - b. Stockham

2.2 MATERIALS

A. General:

- [illegible]

B. Valve Joints

1. Fabricate valves 2 inches in diameter and smaller of the threaded or solder end type for valves to be installed in copper pipelines, and of the threaded end type for valves to be installed in metal pipelines.
2. Fabricate all valves 2-1/2 inches in diameter and larger, except bronze valves 2-1/2 and 3 inches in diameter, with flanged ends, unless otherwise specified.
3. Fabricate bronze valves 2-1/2 and 3 inches in diameter with solder or threaded type ends for valves installed in copper pipelines and threaded type ends for all other pipelines.
4. For metallic flanged joints, provide flanges that are faced accurately at right angles to the axis of the casting. Face and drill flanges and shop coat with a rust-preventive compound before shipment.
5. For flanged joints, provide flanges whose dimensions and drillings meet the requirements of ASME B16.1, 125 pounds as a minimum. For valves installed in pipelines with test pressure requirements higher than 125 psi, provide flanges whose pressure ratings equal or exceed the specified test pressure of the pipeline. Furnish special drillings where required. For valves having flanges that do not conform with the thickness requirements of ASME B16.1, test each valve in accordance with the hydrostatic shell test pressure requirements of ASME B16.1.

C. Operating Force: Fabricate valves to limit the maximum force required to operate all manual valves, including but not limited to valves with wrench operated nuts, levers, handwheels and chainwheels, to 40 pounds. Limit the overall length of each wrench or single-arm lever to 18 inches. Limit the overall length of each dual-arm lever to 36 inches.

D. Handwheel: Mark each valve handwheel with an arrow and the word OPEN. Mark each nut with an arrow.

E. Manually Operated Valves: Equip all manually operated valves that have operating nuts, levers or handwheels and that are more than 7 feet above the floor with chain operated levers or chainwheels. Extend chains to 7 feet above the floor.

2.3 GATE VALVES

A. Materials: Unless otherwise shown or specified, furnish and install gate valves meeting the following requirements:

| Nominal Valve Size, Inches | Standard | Type |
|----------------------------|-----------|-------------|
| 3 and smaller | MSS SP-80 | Solid wedge |

| | | |
|--|-----------|----------------|
| 4 thru 12 for HVAC Service | MSS SP-70 | Solid Wedge |
| 4 thru 12, except for HVAC Service | AWWA C509 | Resilient seat |
| 16 and larger, except for HVAC Service | AWWA C500 | Double disc |

B. Rising Stems: Manufacture all gate valves with rising stems, unless otherwise shown or specified. Design all gate valves to open when the nut or handwheel is turned counterclockwise.

C. Nonrising Stem: For buried service, furnish nonrising stem gate valves. Equip nonrising stem valves, except for buried or submerged service, with externally visible indication of the disc position at all points of travel.

D. Stem Seals: Use the following types of stem seals:

| Valve Type | Stem Seal |
|-------------------------------------|------------------------|
| Nonrising stem | O-ring |
| Rising stem (Outside stem and yoke) | Stuffing box |
| Geared | |
| Nonrising stem | O-ring or stuffing box |
| Rising stem (Outside stem and yoke) | Stuffing box |

E. Packing: Provide nonasbestos braided, twisted or formed ring type packing suitable for the pressure-temperature ratings of the valve.

F. Bonnet: Provide 3-inch and smaller gate valves with threaded bonnets. Provide 4-inch and larger gate valves with outside screw and yoke bonnets.

G. Accessories: Provide zinc plated bonnet bolts, studs and nuts. except for submerged service. Provide stainless bonnet bolts, studs and nuts for submerged service. Make wedging devices bronze to iron or bronze to bronze. Provide glands which are bronze or bronze bushed and bronze gland bolts and nuts.

2.4 BUTTERFLY VALVES

A. General:

1. Provide butterfly valves 4 inches and smaller of the full lug pattern with drilled and tapped bolt holes.

2. Provide butterfly valves 6 inches and larger of the full flanged pattern that meet the requirements of AWWA C504.

3. Provide butterfly valves of the rubber-seated, tight-closing type.

4. For fluid temperatures equal to or less than 180 degrees F, provide Buna-N seats. For fluid temperatures greater than 180 degrees F, provide EPDM or Viton seats. For fluid temperatures exceeding the temperature ratings of EPDM and Viton, provide seats that are appropriate for the intended service.

B. Materials:

1. For butterfly valves 4 inches and smaller, provide valve materials as specified below or as required for the service.

- a. Valve bodies:
Cast iron ASTM A 126, Class B
- b. Valve shafts:
Stainless steel ASTM A 564, Type 630 (17-4 PH stainless steel)
ASTM A 276 Grade 316
- c. Valve discs:
Aluminum Bronze ASTM B 148
Bronze ASTM B 30
- d. Bearings: TFE coated stainless steel

2. For butterfly valves 6 inches and larger, provide valve materials as specified below or as required for the service:

- a. Valve bodies:
Cast iron ASTM A 126, Class B
ASTM A 48, Class 40
- b. Valve shafts: ASTM A 276 or A 479/A479M, Type 304,
stainless steel or carbon steel with A 276 or A
479, Type 304 stainless steel journals
- c. Valve discs:
Cast iron ASTM A 48, Class 40
Alloy cast iron ASTM A 436, Type 1
Ductile iron ASTM A 536, Grade 65-45-12
Bronze AWWA C504 Grade A, D or E
- d. Mating seat surface:
Stainless steel

| | | |
|----|-----------------|---|
| | (castings) | ASTM A 743/A743M, A 744 Grade CF-8 or CF-8M |
| | Stainless steel | ASTM A 276 or A479, Type 304 |
| | Alloy cast iron | ASTM A 436, Type 1 |
| e. | Seats: | Buna-N (Wastewater) New natural rubber or Buna-N (Water) Neoprene (Air) |

C. General AWWA C504 Construction: For butterfly valves 6 inches and larger, manufacture valves and all accessories, including operators, to meet the requirements of AWWA C504, except as otherwise specified. Provide valve bodies of the short-body flanged type or mechanical joint-end type, as shown or specified. Wafer body type valves without lugs are not acceptable.

D. Pressure: Provide butterfly valves of pressure classes that are not less than Class 25B, that exceed the pipeline test pressure in which the valve is installed, or that are as specified, whichever is greater.

E. Shafts: If stub shafts are furnished, extend the shafts a minimum of 1-1/2 diameters into the discs and provide clearance between the shaft and discs not exceeding the following:

| <u>Shaft Diameter (Inches)</u> | <u>Maximum Radial Clearance (Inches)</u> |
|------------------------------------|--|
| 1/2 to 1-1/2 | .002 |
| 2 to 4 | .0025 |
| 5 | .003 |
| 6 | .004 |

F. Extended Necks: Provide butterfly valves in insulated lines with extended necks to clear insulation.

2.5 ECCENTRIC PLUG VALVES

A. General: Provide quarter turn valves having an eccentric action that causes the plug to rise off the seat contact during the opening movement rather than sliding from its seat.

B. Plugs: Provide plug valves with Neoprene or Buna-N faced plugs.

C. Materials: Construct plug valves of cast iron or semi-steel at least equal to ASTM A 126, Class B. For valve sizes 3-inch and larger, construct the body seats with a welded-in overlay, of not less than 90 percent pure nickel, on all surfaces contacting the plug face. For

valve sizes under 3-inch provide uncoated or epoxy coated body seats. Make the overlay a minimum of 1/16-inch thick for valve sizes 20-inch and smaller and a minimum of 1/8-inch thick for valve sizes 24-inch and larger. Provide zinc plated bonnet bolts, studs and nuts.

D. Seat Adjustment: Make the water-tightness or gas-tightness of the valve seating adjustable. Provide a seating adjustment device that is external to the valve and that can be used without the need to remove the valve from the piping and with the valve under pressure.

E. Lubrication: Furnish plug valves with oil impregnated, permanently lubricated, Type 316 stainless steel bearings in the upper and lower journals.

F. Stem Seal: Provide a stem seal consisting of multiple, self-adjusting and replaceable chevron type packing rings and a packing gland or provide two replaceable, self-adjusting, U-cup seals. Make the stem seal adjustable and replaceable without removing the valve from the piping and without the need to disassemble the valve and operator. For buried or submerged service, provide a sealed enclosure to keep the stem seal clean.

G. Valve Port: Unless otherwise specified, construct the valve with a minimum port area of 80 percent of the full area of the pipe in which the valve is installed.

H. Multiport: Provide 3 and 4-way valve configuration when shown or specified.

I. Position Indicator: Equip plug valves, except for buried or submerged service, with external visible indication of the plug position.

J. Operators: Unless otherwise shown or specified, equip 6-inch and smaller valves with wrench or lever operators and 8-inch and larger valves with gear operators. Equip all valves in low pressure gas service with gear operators. Furnish one wrench for each size valve in each individual room or space in which valves are located. House gear operators for submerged or buried service in a watertight enclosure. For buried or submerged service, equip valve operators with stainless steel external bolting.

2.6 LUBRICATED PLUG VALVES

A. General: Design semisteel lubricated plug valves for operating pressures of not less than 125 pounds steam or 200 pounds water, oil, or gas. Provide port opening areas not less than 80 percent of the pipe area. Provide plugs that rotate 90 degrees from full open to full closed and that are equipped with stops. Design the valves so that excessive lubricant pressure cannot be built up and lubricant cannot be forced into the pipeline. Provide lubrication through Alemite fittings on the body of the valve.

B. Seals: Accomplish sealing at the operating end of the plug by means of a teflon gasket held in leakproof contact between the plug and body by means of a coil spring at the

base of the plug or by means of resilient packing and a bolted gland or plastic packing applied under pressure. If resilient or plastic packing is used, provide for replacing the packing while the valve is under pressure.

C. Lubricants: Provide lubricants suitable for use with the fluid handled through the valve. Furnish not less than two pounds of lubricant for each valve after the initial lubrication has been made.

D. Operators: Equip 6-inch and smaller lubricated plug valves with wrench-operators and 8-inch and larger valves with gear-operators, unless otherwise shown or specified. Furnish one wrench for each size of valve in each individual room or space in which valves are located.

2.7 SINGLE DISC SWING CHECK VALVES

A. General: Provide single disc swing check valves designed to allow a full diameter passage and to operate with a minimum loss of pressure. Provide 1/8 through 3 inch check valves that meet the requirements of MSS SP-80. Except as specified herein, provide 4 inch through 24 inch check valves that meet the requirements of AWWA C508. For heating, ventilating or air conditioning service, provide 4 inch through 24 inch check valves that meet the requirements of MSS SP-71.

B. Design: Equip check valves with bronze renewable seat rings, bronze discs or disc rings and bronze disc hinge bushings and pins. Carefully mount discs and provide discs that swivel in disc hinges. Provide pins, discs and other parts that are noncorrosive, nonsticking and properly cured to operate satisfactorily within a temperature range of 34 to 100 degrees Fahrenheit and with the fluids or gases specified.

C. Levers and Weights: Equip 6 inch and larger check valves with outside levers and weights.

2.8 DOUBLE DISC CHECK VALVE

A. General: Provide double disc check valves that are of the double plate and flat seat design with a center located, vertical hinge pin. Design the valves for tight shutoff under all reverse flow and head conditions.

B. Working Pressure: Design the valves for a minimum working pressure of 125 pounds per square inch. Provide end connections that are designed to fit between ASME B16.1 flanges.

C. Construction Materials: Construct the valve body and discs of cast iron. Provide Buna-N seal materials. Use stainless steel Type 316 springs.

2.9 MANUAL BUTTERFLY VALVE OPERATORS

- A. General: Provide operators as an integral part of the valve. Manufacture manual operators of the enclosed, hand-lever, traveling-nut or worm-gear type, as shown or specified.
- B. Hand-Lever Type: Fabricate hand-lever type operators of cast-iron or steel construction with a nonmetallic, nonslip handgrip. Equip the lever with a locking device to secure the valve disc in the fully open or fully closed position, or at a minimum of 5 intermediate positions at 1___degree intervals. Provide mechanical stop-limiting devices to prevent overtravel of the disc in either direction. Permanently lubricate operators or provide operators with grease fittings.
- C. Traveling-Nut Type: Fabricate traveling-nut type operators with a threaded steel screw and a bronze nut. Provide a slotted-lever or link-lever system to transfer the applied torque to the disc shaft. Equip all rotating shafts, screws and links with separate bearings. Provide thrust bearings.
- D. Worm-Gear Type: Fabricate worm-gear type operators with a worm gear and matching drive worm. Provide bearings for each rotating member.
- E. Stop-Limiting Devices: Provide stop-limiting devices on traveling-nut and worm-gear type operators to prevent overtravel of the disc in either direction. Design the operator to hold the disc in any position without flutter or wear on the valve or operator. House the operator in a watertight enclosure. Pack operators with grease or with oil. For buried or submerged service, equip valve operators with stainless steel external bolting.
- F. Position Indicators: For buried or submerged service, equip manually operated butterfly valves, with externally visible indication of the disc position.

2.10 CHAINWHEEL OPERATORS

- A. General: Manufacture chainwheels and chain guides of cast iron or ductile iron. Coat chainwheels and chain guides by hot dip galvanizing in accordance with the requirements of Section 05 05 13.
- B. Chains: Manufacture chain of steel. Use welded link chain meeting the requirements of the National Association of Chain Manufacturers (NACM) Grade 28 or single loop weldless chain meeting the requirements of NACM No. 6001. Coat chain by hot dip galvanizing meeting the requirements of Section 05 05 13. Remove excess metal at welded chain joints for proper fit into the chainwheel pockets. Remove burrs and sharp edges. Furnish chain that is suitable for bare hand operation.

2.11 FLOOR AND BENCH STANDS

- A. General: Provide floor and bench stands for valves smaller than 12 inches of the wheel operated type without gears. Provide stands for 12- to 20-inch valves of single crank, single speed operated. Provide stands for 24-inch and larger valves of single crank, single speed or 2-speed operated as specified.
- B. Materials: Use materials in floor and bench stands meeting the applicable requirements of the "General" specifications subsection. Provide frames of cast iron or fabricated steel of heavy and substantial design with smooth exterior and neat appearance. Make adequate provision for lubrication and protect all operating parts.
- C. Nameplate and OPEN Indication Marking: Equip each stand with a nameplate stating the valve controlled by the stand and also stamp the operator with an arrow and the word OPEN to indicate the direction of rotation.
- D. Rising Stems: Fit rising stem floor and bench stands with ball or roller bearings designed to take the thrust. Equip rising stem stands with a transparent plastic cover to protect the stem. Provide the cover with labels and other attachments that will facilitate its use as an indicator of valve position.
- E. Nonrising Stems: Fit nonrising stem floor and bench stands with thrust ball or roller bearings. Provide an indicator to show the position of the valve.
- F. Operating and Lift Nuts: Provide operating nuts or lift nuts of bronze meeting the requirements of ASTM B 62, finished all over, suitably splined to connect with the handwheel or gear and with threads which will engage smoothly with those of the lifting shaft.
- G. Crank-Operated Stands: Provide crank-operated stands with a crank that will open the valve when the crank is turned counterclockwise. Locate the center of the crank approximately 36 inches above the operating floor. Provide gears which are bevel or worm, of hardened steel or manganese bronze, with machine cut teeth and enclosed in a cast-iron body. Equip the crank with a brass or bronze sleeve-type handgrip rotating freely on the handle. Utilize a gear ratio that will enable the stand to operate the valve with a maximum force of 40 pounds on the crank at single or low speed.
- H. Handwheel-Operated Stands: Provide handwheel-operated stands with handwheels that open the valve when the wheel is turned counterclockwise. Locate the center of the handwheel approximately 36 inches above the operating floor. Provide a handwheel of sufficient diameter so that the stand will operate the valve with a maximum pull on the handwheel of 40 pounds.

I. Manually Operated Bench Stands: Equip manually operated bench stands located more than 7 feet above the floor with chains and chainwheels that meet the requirements of the subsection headed "Chainwheel Operators".

2.12 ELECTRIC MOTOR OPERATORS - NONMODULATING

A. General: Provide nonmodulating electric motor operators of the close-coupled, electric motor-driven, worm gear type, complete with motor, gearing, limit switches and auxiliary contacts, torque switches, position indicator, handwheel, integral controller, and all required appurtenances. Design the operators to (rotate valve discs through 90 degrees from the fully open to the fully closed position and back, as in butterfly, ball or plug valves,) (lift gate discs from the fully closed to the fully open position and back, as in gate valves). Provide operators that complete each operation in the time specified. Provide operators that hold the discs in any position from fully open to fully closed without vibration.

B. Operator Mounting: Design the operator to be mounted in the position shown or specified.

C. Standard: Except as otherwise specified, provide operators meeting AWWA C540.

D. Open and Close Time Periods: Provide valve operators that fully open the valve from the closed position in seconds and fully close it in seconds when the differential pressure and flow are at the values specified for the valve and the voltage at the terminals is within 15 percent of the nominal voltage. Design the operator to operate the valve through three consecutive opening and closing cycles or for a period of 15 minutes, whichever is longer, during every 60-minute period, at specified ambient temperature conditions under full differential pressure.

E. Temperature Range: Design the operator for (indoor) (outdoor) operation and for an ambient temperature range of -20 to 140 degrees F.

F. Torque: Design the operator to exert an unseating torque of at least 50 percent in excess of the required disc seating torque at the specified voltage, neglecting hammer-blow effect.

G. Power Gearing: Provide power gearing consisting of helical or spur gears and worming gearing. Fabricate helical and spur gears of accurately machined hardened alloy steel. Provide a hardened alloy steel worm with threads ground and polished after heat treating. Provide a nickel or manganese bronze worm gear. Use antifriction bearings throughout. Grease pack or oil bath lubricate the operator. Provide lubricants suitable for the ambient temperatures specified.

H. Lost-Motion Device: Design operators for gate valves to include a lost-motion device that will permit the motor to attain full speed, and then impart a hammer blow to the stem nut to start movement of the disc in both the opening and closing directions. Do not include this feature if the valve is for modulating service.

I. Handwheel - Manual Operation: Provide a handwheel for manual operation with a maximum rim pull of 40 pounds. Design the handwheel so that it does not rotate during electrical operation and the motor does not rotate during manual handwheel operation. Provide an operator that is arranged so that motor or motor gearing failure does not prevent manual operation. Arrange the operator to automatically change from manual operation to electrical operation when its motor is energized and to continue electric operation until the operator is reset to manual operation. Provide a means for locking the drive in either manual or motor operation. Provide removable handwheels. Provide an adaptor key or drive nut to permit operation by a portable operator.

J. Declutching Mechanism: Provide a declutching mechanism to disengage the motor mechanically but not electrically from motor to handwheel operation. If the clutch is of the external lever type, arrange it such that the lever does not move when the motor is energized.

K. Position Indication: Provide an operator-mounted disc position indicator of the mechanical or indicating light type. For OPEN-CLOSED service, indicate the fully open, fully closed and intermediate disc position either mechanically or by lights. For modulating or throttling service, provide continuous disc position indication between the fully open and fully closed positions. Provide electrical contacts as required for remote indication of disc position.

L. Electric Motor Design: Provide an operator motor of the high torque, ball or roller bearing, squirrel-cage type designed for continuous valve duty. Provide motor rated for 15 minute duty cycle or three complete opening and closing valve strokes, whichever is longer, during a 60 minute period under full differential pressure at 40 degrees C ambient. Design the motor for use on a nominal 480 volts, 3-phase, 60-hertz electrical service. Provide motor windings and leads with Class F or better insulation with built-in thermal overload protection. In other respects, provide motors meeting the requirements of Section 26 05 80.

M. Housing: Provide housings for controls, gears, and motors with integrally cast flanges. Fully machine and template drill the flanges and their mating surfaces. Provide joints which are metal-to-metal or gasket or O-ring sealed as required.

N. Control and Motor Enclosures: Provide NEMA 4 control and motor enclosures, except as otherwise specified. (Provide NEMA 7 enclosures where explosion-proof construction is shown or specified.) Provide the controller with mechanical interlocks and mount as an integral part of the operator. (For explosion-proof enclosures which are

dependent upon metal-to-metal faces for weatherproofing, include explosion-proof breathers and drains with desiccant type dehumidification and with sufficient silica gel desiccant for 6 months service without requiring renewal. Include instructions for renewal of the desiccant. Provide a 2-year supply of desiccant.)

O. Electrical Compartment Heater: Provide electrical compartment heaters, unless other means can be proven effective for moisture elimination.

P. Electrical Requirements: Provide electrical controls for the operator as shown or specified. Design operators for 480-volt, 3-phase, 60-hertz service. Design all control circuits for 120- volt, single-phase, 60-hertz ac. Provide an integral 480/120-volt control transformer with fused secondary.

Q. Reversing Controller, Overload Protection and Internal Wiring: Provide a NEMA rated reversing controller, or an approved special duty rated reversing controller, complete with mechanical interlocks and controls as an integral part of the operator. Provide adequate overload protection in the controller or embedded in the motor windings. Install an overload device in each phase. If overload devices are installed in the motor windings, provide devices of the (bimetallic automatic reset type) (manual reset type with remote-indication) with the contacts in the control circuit. Arrange the internal wiring in the operator so that the opening and closing coils cannot be energized simultaneously at any time, regardless of external wiring conditions.

R. Push Buttons and Selector Switches: Where operators are 7 feet or closer to the floor and in an accessible location, mount OPEN- STOP-CLOSE push buttons or a selector switch as shown on the operator housing. Also mount red and green position indicator lights and, where shown or required, an amber ready light or MANUAL-AUTO mode selector on the operator housing. Where the operators are located over 7 feet from the floor or in an inaccessible location, connect all internal control and indication wiring to a terminal block within the operator enclosure and provide a separate control station for remote mounting. Provide the remote control station with the same NEMA rating as the operator.

S. Limit and Torque Switches: Provide the operator with limit and torque switches, either direct or gear driven. Provide adjustable limit and torque switches with auxiliary contacts that are operative in either direction of travel. Provide limit switches that are "in step" with torque switches at all times, whether in motor or manual operation. Equip the operator with limit switches to stop movement in each direction and torque switches for protection against mechanical overload and to stop movement in either direction if an obstruction is encountered. Provide the number, function and arrangement of limit switches as shown, specified or required.

T. Additional Accessories: Provide additional limit switches, indicating lights, position transmitters and remote position indicators, remote operating controls and other accessories and controls as shown, specified or required.

U. Control Components, Operator Housing and Operator Wiring: Provide control components and operator housing that meets the requirements of Section 26 05 60. Provide operator wiring that meets the requirements of Section 26 05 19.

2.13 ELECTRIC MOTOR OPERATORS - MODULATING

A. General: Provide modulating motor operators that meet the requirements for nonmodulating operators, except as specified herein. In addition to the other equipment specified for nonmodulating operators, provide an electronic control module and a solid state reversing starter.

B. Control Module: Provide a solid-state type control module with a comparator circuit which senses the error between the input command signal and the position feedback signal. Mount the control module within the operator switch compartment.

Accept a 4-20 mA_{dc} input command signal. Provide zero and span adjustments to align minimum and maximum valve position with zero and 100 percent values of the input command signal. Provide deadband adjustment from 0.16 to 1.0 percent to eliminate excessive motor movement due to minor variation in the process variable signal.

Activate the solid state reversing starter to drive the actuator in the proper direction necessary to reduce the error to zero. Provide proportional band adjustment from 5-40 percent. When the error is outside the proportional band, run the actuator motor continuously toward set point. When the error is within the proportional band, pulse the actuator motor toward set point to prevent overshoot.

Provide actuator to open the valve when command input signal increases.

On loss of command input signal, have valve fail (open) (closed) (in last position).
On loss of feedback signal, have valve fail in last position.

C. Selector Switch and Push Buttons: Where the operator is 7 feet or less from the floor and in an accessible location, integrally mount a 3-position AUTO-OFF-MANUAL selector switch plus two push buttons marked OPEN and CLOSE on the operator housing. Where the operator is located more than 7 feet from the floor or in an inaccessible location, connect all internal control and indication wiring to a terminal block and provide a separate control station for remote mounting.

D. Auto and Manual Operations: Provide operators that, when in the AUTO position, will respond to the automatic signal as described above. Provide operators that, when in the MANUAL position, will be operable by either push buttons or handwheel.

E. Motor Design: Design the motor specifically for valve operator service and to be continuous rated for continuous modulating duty. Provide motor insulation of at least Class H.

2.14 PNEUMATIC CYLINDERS

A. General: Provide pneumatic cylinder operators of the air cylinder type, suitable for constant or variable speed operation in both directions. Provide cylinders that include cylinder body, heads and cap, piston, piston rod, rod bushing seals, tie rods, mounting, and all control valves, complete with pressure piping and fittings.

B. Standard: Except as otherwise specified, provide operators meeting AWWA C540.

C. Cylinder Mounting: Mount the cylinders on the equipment or on separate supports as shown or required. Design cylinders to operate the equipment using compressed air at the specified pressure. Maintain pressure on the cylinder piston to prevent drifting, unless other measures are employed. Design all parts of the cylinder for a safety factor of 5 based on ultimate strengths.

D. Construction: Provide pneumatic cylinders of rolled steel or cast iron with honed liners of 1/8-inch rolled brass or stainless steel tubing or of high-grade seamless cold drawn brass or stainless steel tubing or of glass fiber reinforced epoxy tubing with an integral liner of molybdenum disulfide dispersed in an epoxy matrix. Bronze fit cylinder heads and pistons or otherwise construct and protect them against corrosion. Provide piston rods fabricated of bronze, stainless steel, or steel with a hard nickel or chromium plating. Provide the piston rod with an easily accessible stuffing box, O-rings, or pressure energized seal which will effectively prevent leakage without scouring the rod or causing undue friction. Provide pistons that have two L-shaped or U-shaped cup leathers or sufficient resilient O-rings to prevent leakage past the pistons. Provide bronze gland studs and nuts. Provide tie bolts and nuts fabricated of bronze or ASTM A 29 Grade Designation 1045 steel with cadmium plating. Equip cylinders with Hycar or Teflon dirt wipers and with Hycar or Teflon rod seals of the nonadjustable, wear-compensating type.

E. Cushioning: Provide the cylinders with cushioning at each end of the stroke, by limiting the rate of air exhaust or by a properly designed spring device.

F. Air Openings: Provide openings in the cylinder heads for connection of operating air pipes that are of ample size for the quantity of air required under any operating condition and that are tapped for American Standard Pipe Threads, in accordance with ASME B1.20.1.

G. Mechanical Indicator: Provide a mechanical indicator for each valve that is designed to indicate all positions from open to closed.

H. Limit Switches: Provide each pneumatic cylinder with limit switches arranged to operate as the valve moves into the closed or open position, (except where such switches are provided on the valve).

I. Hose: If the cylinders are of the swiveling type, provide a length of hose of the proper size and length at each connection. Provide hose that has an oilproof rubber tube reinforced with high tensile strength rayon fabric and a black, nonpeeling and oilproof, rubber cover.

J. Opening and Closing Times: Equip the cylinders with needle valves and check valves as required to adjust the opening and closing times within the limits specified. Provide an adjustable opening time and an adjustable closing time. Needle valves and check valves may be an integral part of the cylinder or may be separately mounted.

K. Control Piping: Provide copper tubing control piping meeting the requirements of Section 40 05 18 and neatly arranged and mounted on a plate mounted on the equipment or on the cylinder operator. Provide air control piping that includes a filter and pressure regulator. If the air cylinders are equipped with pistons having a cup leather or similar seals requiring lubrication, provide an oil fog unit in the air control piping. Assemble the oil fog unit, if required, the filter unit and the pressure regulator as a single unit.

2.15 AIR-OIL CYLINDER OPERATORS

A. General: Provide air-oil cylinder operators that are of the air cylinder type with hydraulic damper, suitable for variable speed operation in both directions and timed opening and closing. Provide operators consisting of an air cylinder, oil cylinder, oil reservoir, timing valves and appurtenances. Provide air and oil cylinders that meet the requirements of the subsection headed "Pneumatic Cylinders".

B. Auxiliary Control Valve and Piping: Furnish an auxiliary control valve and piping to provide emergency fast closing in case of power failure.

C. Control Piping: Provide copper tubing control piping meeting the requirements of Section 40 05 18 and neatly arranged and mounted on a brass plate mounted on the valve.

D. Limit Switches: Provide each cylinder-operated valve with two 2-position, snap-action limit switches, with two normally open and two normally closed contacts. Arrange the switches to operate as the valve moves into the closed and open positions and mount them with their shafts beyond the point of contact with the operating levers. Furnish switches with 10-ampere, 125-volt contacts in NEMA Type 4 general purpose enclosures.

2.16 LOW PRESSURE HYDRAULIC CYLINDERS

A. General: For low pressure water operation, provide hydraulic cylinders of rolled steel, red brass or stainless steel tubing, or of high-grade seamless cold-drawn brass or stainless steel tubing or of glass fiber reinforced epoxy tubing with an integral liner of molybdenum disulfide dispersed in an epoxy matrix. Bronze fit cylinder heads or otherwise fabricate and protect them against corrosion and tuberculation. Provide pistons and piston rods fabricated of bronze, stainless steel or steel with hard nickel or chromium plating. Provide the piston rod with an easily accessible stuffing box, O-rings, or pressure energized seal which will effectively prevent leakage without scoring the rod or causing undue friction. Provide the piston with two L-shaped cup leathers or sufficient resilient O-rings to insure against leakage past the pistons. Provide bronze gland studs and nuts and head tie bolts and nuts. Mount the cylinders on the valve bodies or on separate supports as shown or specified. Design cylinders to operate the valves at the unbalanced pressures specified with power water.

B. Opening and Closing Times: Equip the cylinders with needle valves and check valves as required to adjust the opening and closing times within the limits specified. Needle valves and check valves may be an integral part of the cylinder or may be separately mounted.

C. Hose: If the cylinders are of the swiveling type, provide a length of hose of the proper size and length at each connection. Provide 4-ply hose for 1 inch and larger, and 3-ply hose for smaller sizes. Provide rubber hose reinforced with medium weight square woven duct wrapped at a 45-degree angle.

D. Tapped Openings: For control piping, provide tapped openings in the hydraulic cylinder heads of the largest practicable size and tapped for American Standard pipe threads in accordance with ASME B1.20.1.

E. Mechanical Indicator: For each valve provide a mechanical indicator that is designed to indicate all positions from opened to closed.

F. Limit Switches: Equip each cylinder with limit switches arranged to operate as the valve moves into the closed or opened position, (except when such switches are provided on the valve).

2.17 HIGH PRESSURE HYDRAULIC CYLINDERS

A. General: Size high pressure hydraulic cylinders for operation with power oil at 800 psig. Design the cylinders for mounting as shown. Provide cylinders suitable for oil operation, designed for a working pressure of 2,000 psig and meeting the applicable requirements of AWWA C540.

B. Speed Controls: Fit the cylinder with speed controls to close the valves completely and to open them at the rates as specified. Equip each speed control unit with an integral reverse flow check valve.

C. Mechanical Indicator: Provide a mechanical indicator for each valve. Design it to indicate all positions from opened to closed.

D. Fluid Power System: Provide fluid power equipment for the hydraulic cylinders that uses oil as the power medium and that consists of an hydraulic power unit, an accumulator bank, miscellaneous valves, gauges, pressure switches and all other appurtenances necessary to provide a complete and operable system as specified herein. The arrangement of the system components shown on the line diagram may not necessarily incorporate all of the appurtenances required to provide the operation specified. Design the fluid power system to meet the following conditions:

1. Maximum pressure of 2,000 psig and maximum pressure at the operating cylinders of 800 psig.
2. Start at a pressure of 1,700 psig and stop lead pump at a pressure of 2,000 psig. Start second pump at a pressure of 1,600 psig and stop second pump at a pressure of 2,000 psig.
3. Arrange the hydraulic system to (close) (open) the valves on power failure.
4. Arrange the hydraulic system to (open) (close) the valves on restoration of power, only when the pressure in the system is above 1,600 psig.
5. Arrange the hydraulic system to provide for a contact to actuate an alarm at a pressure of 1,500 psig or less.

E. Hydraulic Power Unit: Provide a completely assembled hydraulic power unit consisting of a storage reservoir, two hydraulic pumps with suction filters, a pressure-relief valve, check valves, gauges, a pressure-reducing valve, two directional valves, pressure switches and appurtenances. Assemble the system appurtenances on a rigid steel frame.

F. Reservoir: Provide a reservoir. Mount the reservoir on steel legs so that the bottom of the reservoir is approximately 6 inches above the floor. Fabricate the reservoir of steel. Mount the two motor-driven hydraulic pumps on the reservoir. Fit the reservoir with a combination filler with strainer and air filter; cleanout opening with cover; full height oil level gauge; tank with valve; return and supply fittings; internal baffles; and a 74-micron telltale type suction filter for each pump supply line. Provide a permanent magnet with each suction filter. Provide filters and magnets that are removable without draining the reservoir. Slope the reservoir bottom to the drain.

G. Directional Valves: Provide 4-way, 2-position, single solenoid, spring return type directional valves designed for a flow rate of 30 gpm and capable of passing 20 gpm with no more than 50 psig pressure drop.

H. Pressure-Reducing Valves: Provide pressure-reducing valves capable of maintaining the pressure on the outlet side at 800 psig.

I. Pilot-Operated Check Valves: Provide pilot-operated check valves with a 5:1 piston ratio.

J. Accumulators: Provide not less than __ accumulators, each having a capacity of 10 gallons. Provide gas-loaded, piston type, hydraulic accumulators. Mount the accumulators in a vertical position with all accumulators grouped together and factory assembled in a suitable supporting frame. Pipe accumulators together at the factory requiring only external piping connections in the field. Provide each accumulator assembly with an accumulator charging and gauging assembly.

K. Pipe and Fittings: Provide pipe consisting of low carbon, seamless steel, hydraulic tubing, fully annealed, suitable for bending and flaring, that meets the requirements of SAE J356, J524, or J525, and of the wall thicknesses recommended by the joint industry conference for hydraulic equipment for the service specified. Provide fittings of the SAE hydraulic 37-degree flare type, Triple-Lok style.

2.18 CONTROL VALVES

A. Manual Operated: For manually operated 4-way control valves associated with pneumatic and low pressure hydraulic cylinders, provide disc, packless type valve for valves 1-1/4 inches and less in size and eccentric plug valves that meet the requirements of Subsection headed "General" and "Eccentric Plug Valves" for valves larger than 1-1/4 inches in size.

B. Solenoid-Operated: Provide 4-way, differential-operated, packless, poppet seat type solenoid-operated control valves with all parts rustproof and noncorrosive. Provide coils of the molded type, Class B insulated, in NEMA Type 4 Enclosure for nonhazardous areas and NEMA Type 7 for hazardous areas, designed for operation using 120-volt, 60-hertz current. Provide single-solenoid type valves. Arrange the solenoid such that when energized it positions the 4-way valve to open the cylinder-operated valve and when de-energized, it positions the 4-way valve to close the cylinder-operated valve. Arrange the 4-way valves for manual operation independent of and without disturbing the electrical control.

2.19 EXTENSION STEMS, VALVE BOXES AND FLOOR BOXES

A. Equip all direct burial valves and valves in vaults or manholes with operating nuts and extended shafts to grade, unless otherwise shown or specified. Equip all direct burial valves with adjustable type, cast-iron, valve boxes and extended shafts to grade. Equip all valve boxes and floor boxes with ground level valve position indicators, unless otherwise shown or specified. Provide two tee wrenches for each size and type of operating nut.

2.20 SOURCE QUALITY CONTROL

A. Eccentric Plug Valve Leakage Test: Perform a plug leakage shop test on each eccentric plug valve with the plug in the closed position. Unless otherwise specified, perform the leakage test with a minimum pressure of 150 pounds per square inch (gauge) applied sequentially to both the upstream and downstream faces of the plug. Perform the test for a minimum duration of 15 seconds. Demonstrate that there is no leakage past the plug.

B. Eccentric Plug Valve Hydrostatic Test: Give each eccentric plug valve hydrostatic shop pressure tests with the plug open and with the plug closed. Perform the hydrostatic tests with a minimum pressure that is at least equal to the test pressure specified for the pipeline in which the valve is installed. Perform the test for a minimum duration of 30 seconds. Demonstrate with the hydrostatic tests that the valve is structurally sound and that there are no leaks through the external surfaces of the valve.

C. Hydraulic Power Unit Shop Test: Prior to shipping the fluid power unit, conduct a shop test that demonstrates that the unit fulfills the operating requirements of the Specifications.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install valves in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

B. Eccentric Plug Valves: Unless otherwise shown or specified for eccentric plug valves installed in horizontal piping, orient the valve such that the shaft is in the horizontal position, the seat is in the downstream position and when the valve is in the open position the plug is up. Unless otherwise shown or specified, for eccentric plug valves installed in vertical piping, orient the valve with the plug up when the valve is in the closed position.

C. Floor and Bench Stands: Accurately center floor and bench stands over the valve. Solidly bolt stands to the floor or support structure, with through-bolts wherever possible. Place approximately 3/4 inch of nonshrink cement grout beneath stands mounted on

concrete or similar construction to assure uniform support. For stands installed within the area of a removable type floor, platform, or grating, securely mount them on their own support structure independent of the removable element, unless otherwise shown or specified.

3.2 PAINTING AND COATING

A. General: Unless otherwise specified, coat the inside iron or steel surfaces of all valves and exterior surfaces of valves and operators that are to be buried in the ground or immersed in sewage or water with two coats of asphalt varnish. Paint exterior surfaces of other valves and operators as specified in Section 09 96 00.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Furnish the services of a qualified representative of each of the various manufacturers to provide (instruction on the proper installation of the equipment,) (inspect the completed installation,) (make any necessary adjustments,) (participate in the startup of the equipment,) (participate in the field testing of the equipment) (and place the equipment in trouble-free operation), as specified in Division 1.

B. Tests: After installation of the valves, control equipment and all appurtenances, subject the units to a field running test, as specified in Division 1, under actual operating conditions. Operate each valve through one complete open-close cycle under the maximum pressure differential practical.

3.4 OPERATION DEMONSTRATION

A. Manufacturer's Field Services: Furnish the services of a qualified representative of each of various manufacturer's to demonstrate the proper operation and instruct (plant) (pump station) personnel in the equipment's operation and maintenance, as specified in Division 1.

3.5 PAINTING

A. Paint the equipment in accordance with the requirements in Section 09 96 00.

3.6 SCHEDULE

A. Abbreviations used in the schedule are as follows:

Joints

| | |
|-----|-----------------|
| B&S | Bell and Spigot |
| F | Flanged |
| G | Grooved End |

VALVES

| | |
|----|------------------|
| Lu | Lug |
| MJ | Mechanical Joint |
| Sc | Screwed |
| Sd | Soldered |
| SW | Solvent Welded |
| W | Welded |

Operators

| | |
|----|--|
| AC | Air-Oil Cylinder |
| BS | Bench Stand |
| D | Diaphragm |
| E | Electric Motor (Nonmodulating) |
| F | Float |
| FS | Floor Stand |
| H | Handwheel |
| HC | Hydraulic Cylinder (High Pressure) |
| L | Lever |
| ME | Modulating Electric Motor |
| N | Nut |
| PC | Pneumatic Cylinder |
| S | Solenoid |
| WC | Water Cylinder (Low Pressure Hydraulic Cylinder) |

END OF SECTION 40 05 2

(NO TEXT FOR THIS PAGE)

SECTION 40 05 21 – TELESCOPIC VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for furnishing and installing telescopic valves and operators together with all accessories and appurtenances necessary for a complete installation. Install the valves in the rapid mix chemical feed tank as shown.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 09 96 00 - High Performance Coatings

1.2 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Shop Drawings: Submit shop drawings including arrangement and erection drawings of the equipment.

C. Quality Control: Submit manufacturer's certified performance and material records as required.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products as specified in Division 1.

PART 2 PRODUCT

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Telescopic Valves
 - a. Golden Harvest, Inc. (Model GH-900, or approved equal)
 - b. Envirex
 - c. FMC Corp., Environmental Equipment

2.2 DESIGN

A. Provide telescopic valves that include sliding tubes, receiving pipes, support pedestal, guide collar and gasket assemblies, lifting stems, calibrated indicating strip, and floor stand mounted operators. Design valves to provide a vertical travel of 1'-6" feet. Design the sliding tube to operate in a 4-inch diameter cast-iron receiving pipe.

1. Make the valve driptight in any position.
2. Provide manual operators of the rack and pinion or the nonrising stem type. Provide locking and indicating devices calibrated to 1/2-inch of travel.

2.3 CONSTRUCTION

A. General: Fabricate the sliding valve tube of seamless brass or 304 stainless steel tubing and with a minimum wall thickness of 1/8 inch. Lifting bails shall be manufactured from 304 stainless steel. Bail shall be designed for bolting to slip tube and provide for connection to the lifting stem. Tube shall be 6" longer than required travel. Make the outside diameter of the tube not less than 1/4-inch smaller than the inside diameter of the receiving pipe for 4-inch valves and 1/2-inch smaller for larger valves. Construct the tube guide collar of steel or cast iron. Provide a collar with a neoprene gasket or O-ring gasket combination for sealing.

B. Tube Top: Furnish the tube with its top (cut square) (provided with two 90-degree V-notched weirs located 180 degrees apart. Cut V-notch not less than 1-1/2 inches deep.)

C. Operators:

1. Roller bearing supported non-geared hand wheel type. Body shall be anodized aluminum; hand wheel shall be aluminum with min. diameter of 17-inches. Pedestals shall either be of the straight or offset type and shall be fabricated steel with epoxy coating. A keyed anti-rotation plate shall be provided between operator and pedestal mounted base.
2. Design each operator so that the sliding tube moves only in a vertical direction and does not rotate when the valve is operated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install telescopic valves in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Furnish the services of a qualified representative of the manufacturer to provide (instruction on the proper installation of the equipment,) (inspect the completed installation,) (make any necessary adjustments,) (participate in the field testing of the equipment) (and place the equipment in trouble-free operation), as specified in Division 1.

B. Tests: After installation of the telescopic valves and all appurtenances, subject the units to a field test, as specified in Division 1, under actual operating conditions.

3.3 PAINTING

A. General: Paint telescopic valves as specified in Section 09 96 00.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 40 05 53 - IDENTIFICATION FOR PROCESS PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Section 09 91 23 – Interior Painting
2. Section 09 91 13 – Exterior Painting
3. Section 26 05 53 – Identification for Electrical Systems

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

B. 10 State Standards.

1.3 SUBMITTALS

A. Section 01 33 00 "Submittal Procedures": Requirements for submittals.

B. Product Data: Submit manufacturer's catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color-coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit two labels for each size used on Project. Submit samples of each color, lettering style, and other graphic representation required for each identification material or system. Provide a mock-up type sample installation.

- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Maintenance Data: Include product data and schedules in the appropriate operation and maintenance manuals.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- H. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Closeout Procedures: Closeout submittals.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 77 00 "Closeout Procedures": Maintenance material submittals.
- B. Extra Stock Materials: Furnish two containers of spray-on adhesive. Furnish a minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional plastic laminate engraving blanks of assorted sizes.
- C. Tools: Furnish special tools and other devices required for Owner to reinstall tags.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.7 QUALIFICATIONS

- A. Manufacturer: Provide the specified items from firms specializing in manufacturing identification devices of types and sizes required in this Section, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

- a. Red Valve Company
- b. Approved Equal

2. Furnish materials according to ASME A13.1.

- B. Description: Laminated three-layer plastic with engraved white letters on black, contrasting background color.

2.2 TAGS

A. Valve Tags:

1. Manufacturers:

- a. Red Valve Company
- b. Approved Equal

2. Description:

- a. Brass 19-gauge construction; stamped ¼-inch high letters with sequence valve numbers ½-inch high. Provide a 5/32-inch hole for the fastener.
- b. Fill tag engraving with black enamel.
- c. Minimum tag size and Configuration: 1-1/2-inch diameter with finished edges.
- d. Fasteners: Provide the manufacturer's standard solid brass chain wire link or beaded type, or solid brass S-hooks of the sizes required for proper attachment of the tags to valves, and manufactured specifically for that purpose.

B. Plastic Tags:

1. Manufacturers:

- a. Red Valve Company
- b. Approved Equal

2. Description:

- a. Provide the manufacturer's standard pre-printed accident-prevention tags, of plasticized card stock with a matte finish suitable for writing, which are approximately 3 1/4-inch x 5 5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as example: DANGER, CAUTION, DO NOT OPERATE).

C. Metal Tags:

1. Manufacturers:
 - a. Red Valve Company
 - b. Approved Equal
2. Description:
 - a. Brass construction; stamped letters.
 - b. Minimum Tag Size and Configuration: 1-1/2 inches; square with finished edges.

D. Information Tags:

1. Manufacturers:
 - a. Red Valve Company
 - b. Approved Equal
2. Description:
 - a. Clear plastic with printed WARNING message.
 - b. Minimum Tag Size: 3-1/4 by 5-5/8 inch.
 - c. Furnish grommet and self-locking nylon ties.
3. Tag Chart: Typewritten, letter-size list of applied tags and location, in anodized aluminum frame.

2.3 PIPE MARKERS

- A. Color-Coding: Conform to 10 State Standards Section 2.14.
- B. Lettering Size: Conform to ASME A13.1.
- C. Plastic Pipe Markers (applies to piping not continuously color coded):
 1. Manufacturers:
 - a. Red Valve Company
 - b. Approved Equal

2. Pressure-Sensitive Type: Provide the manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ASME A13.1
 3. Insulation: Furnish 1-inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F or greater. Cut the insulation length to extend 2 inches beyond each end of the plastic pipe markers.
 4. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around the pipe at each location fastened by one of the following methods:
 - a. Adhesive lap joint in pipe marker overlap.
 - b. Laminated or bonded application of pipe marker to pipe or insulation.
 - c. Taped to the pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾-inches wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.
 5. Large Pipes:
 - a. May have maximum sheet size with spring fastener.
 - b. For external diameters of 6 inches or larger (including insulation if any) provide either full-band or strip-type pipe markers, but not narrower than 3 times the letter height (and of required length), fastened by one of the following methods:
 - 1) Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2) Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 - 3) Strapped-to-pipe (or insulation) application of semi-rigid type, with the manufacturer's stainless steel bands.
 6. Lettering: Comply with the piping system lettering nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
 - a. Arrows: Print each pipe marker with arrows indicating the direction of flow, either integrally with the piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
- D. Plastic Tape Pipe Markers:
1. Manufacturers:
 - a. Brady ID.
 - b. Allen Systems, Inc.
 - c. Seton Name Plate Corp.

- d. Approved Equal.
 - 2. Description: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Plastic Underground Pipe Markers:
- 1. Manufacturers:
 - a. Red Valve Company
 - b. Approved Equal
 - 2. Description:
 - a. Brightly colored, continuously printed plastic ribbon tape.
 - b. Minimum 6 inches wide by 4 mil thick.
 - c. Manufactured for direct burial service.
 - d. Provide multi-ply tape consisting of solid aluminum foil core between 2 layers of plastic tape.
- F. Engraved Plastic-Laminate Signs
- 1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses required, engraved with the engraver's standard letter style of the sizes and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of the substrate.
 - 2. Provide tags 1/8-inch thick.

2.4 LABELS

- A. Manufacturers:
- a. Red Valve Company
 - b. Approved Equal
- B. Description:
- 1. Laminated Mylar construction.
 - 2. Minimum Size: 1.9 by 0.75 inches.
 - 3. Adhesive backed, with printed identification.

2.5 LOCKOUT DEVICES

- A. Lockout Hasps:

1. Manufacturers:
 - a. Red Valve Company
 - b. Approved Equal
 2. Description:
 - a. Anodized aluminum construction.
 - b. Furnish hasp with erasable label surface.
 - c. Minimum Size: 7-1/4 by 3 inches.
- B. Valve Lockout Devices:
1. Manufacturers:
 - a. Red Valve Company
 - b. Approved Equal
 2. Description:
 - a. Nylon construction.
 - b. Furnish device preventing access to valve operator and accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 01 73 00 - Execution.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
 1. Prepare surfaces as specified in Division 9.

3.2 INSTALLATION

- A. Process Equipment
 1. Identify equipment with engraved plastic nameplates on or near each major item of mechanical equipment and each operational device as specified. Provide signs for the following general categories of equipment and operational devices:
 - a. Main control and operating valves.
 - b. Meters.
 - c. Pumps, compressors, blowers, and similar motor-driven units.
 - d. Tanks.

- e. Chemical feed skids.
 - f. Granulated activated carbon skid unit.
 - g. Oxidation/filtration skid unit.
 - 2. Lettering Size: Use a minimum 1/4 inch high lettering for name of unit where viewing distance is less than 2 feet 0 inches, 1/2-inch for distances up to 6 feet 0 inches, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of the size of the principal lettering.
 - 3. Text of Signs: In addition to the name of the identified unit, provide lettering to distinguish between multiple units, inform the operator of operational requirements, indicate safety and emergency precautions.
- B. Identify every valve with a valve tag.
- C. Identify control panels and major control components outside panels according to Section 26 05 53 – Identification for Electrical Systems.
- D. Install identifying devices after completion of coverings and painting.
- E. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- F. Labels:
- 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 - 2. For unfinished covering, apply paint primer before applying labels.
- G. Tags:
- 1. Install tags using corrosion-resistant chain.
 - 2. Number tags consecutively by location.
- H. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- I. Identify valves in main and branch piping with tags.
- J. Piping:
- 1. Identify piping, concealed or exposed, with plastic tape pipe markers.
 - 2. Use tags on piping 3/4-inch (20-mm) diameter and smaller.
 - 3. Identify service, flow direction, and pressure.
 - 4. Install in clear view and align with axis of piping.
 - 5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

3.3 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical device which has become visually blocked by the Work of this division or other divisions.
- B. Cleaning: Clean the face of identification devices.

END OF SECTION 40 05 53

(NO TEXT ON THIS PAGE)

SECTION 40 71 13 – MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Electromagnetic flow meters for permanent installations both above and below ground. The meters shall utilize bipolar pulse DC coil excitation to measure voltage induced by the flow of conductive liquid through a magnetic flux. The voltage shall be linearly proportional to flow velocity.

1.2 SUBMITTALS

- A. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports

- 1. Product Data:

- a. Dimensional Drawings.
- b. Materials of Construction
 - 1) Sensor.
 - 2) Liner.
 - 3) Electrodes.
 - 4) Flanges.
- c. Measurement accuracy.
- d. Range and range ability.
- e. Enclosure Rating.
- f. Classification Rating.
- g. Power:
 - 1) Voltage.
 - 2) Wattage.
- h. Output options.

1.3 QUALITY ASSURANCE

- A. Manufacture facilities shall be certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
- B. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced.

1.5 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 WARRANTY

- A. The meter shall have standard one year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.

1.7 MAINTENANCE

- A. Provide all parts, necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. EuroMag MUT2300US Magnetic Flow Meter
- B. Approved Or-Equal

2.2 MANUFACTURED UNITS

- A. The flow meter shall be a flanged sensor (by application and instrument schedule) and transmitter which may be mounted integral (compact) to the sensor or remote with interconnecting cables up to 650 feet in length.
1. The flow metering system shall be microprocessor-based and possess a non-volatile memory to store the sensor calibration and transmitter setup information. The electronics shall be interchangeable for meters sizes 1" - 90".
 2. The sensor shall be the proper size to measure the design flow rate of the piping and measure bi-directional flow as a standard.
 3. The sensor shall consist of a stainless steel flow tube with ANSI B16.5 or AWWA C207 carbon steel or stainless steel flanges. The flanges shall be Class 150 for 24" and smaller, and AWWA Class D for 28" and larger (listed by the application and instrument schedule).
 - a. Sensors from 1"-12" shall have fixed or rotating lap joint flanges.
 - b. Sensors from 14"-90" shall have the flanges welded to the sensor body.
 4. The sensor liner and electrode material shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5µS/cm (20µS/cm for deionized water).
 5. The sensor tube shall be lined with polyurethane, hard rubber or PTFE in accordance with NSF-61 based upon the size of the flow meter and the process media conditions.
 6. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be bullet-nosed shaped and made of 316L SS or Alloy C22 (listed by the application and instrument schedule).
 7. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
 8. The electrode circuit shall have a minimum impedance of 10^{12} ohms to overcome moderate coating buildup.
 9. The sensor shall be rated for NEMA 4X service as standard.
 - a. An optional sensor rating for NEMA 6/IP67 service shall allow for temporary immersion in water depths of 10 feet for 168 hours OR 30 feet for 48 hours.
 - b. An optional sensor rating for NEMA 6P/IP68 service shall allow for permanent immersion in water depths of 10 feet OR 30 feet for 48 hours.
 10. If NEMA 6 or 6P is specified in the instrument schedule, the transmitter shall be remotely mounted and custom length cables shall be attached at the factory.
 11. In the event of industrial treatment or corrosive/brackish environments, the flow sensor shall be painted and certified according to ISO-12944 corrosion class. Third party modification or sensor preparations will not be accepted without type test documentation to support the exposure conditions, depth and duration of resistance.

- B. The transmitter shall be a three-stage microprocessor controller mounted integrally or remotely as specified in the instrument schedule. The transmitter shall incorporate a universal 100-240 VAC/18-30 VDC power supply. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.
1. The transmitter shall allow local programming that can be operated through the enclosure window without opening the electrical enclosure.
 2. The transmitter display shall indicate simultaneous flow rate and total flow with 3 totalizers (forward, reverse and net total) and user-selectable engineering units, readout of diagnostic error messages, and support 12 standard languages.
 3. The transmitter shall safeguard against entering of invalid data for the particular meter size and all programming parameters shall be access-code protected with a minimum requirement of dual passwords according to data sensitivity.
 4. The transmitter output shall be specified, as either:
 - a. 4-20mA HART®, 0-20mA, pulse/frequency/switch.
 - b. Modbus RS-485
 - c. Profibus® DP
 - d. Or a standard, unmodified form of Ethernet (ex. EtherNet/IP™)
 5. The transmitter output(s) shall be integral to the magnetic flowmeter transmitter electronics; using an external third party signal converter is unacceptable.
 6. There shall be no limitation of transmitter operational capability or diagnostic dependency between integral and compact mounting orientation.
 7. The transmitter output selected must be supported by add-on instructions (AOI), Level 3 add-on profiles (AOP), device drivers (DD), general station description (GSD) files, instructions and pre-engineered code.
 8. The transmitter shall support commissioning options via a service interface or device driver less operation via an internal web server accessible through a transmitter accessible RJ-45 Ethernet port.
 9. The transmitter shall retain all setup parameters and accumulated measurements internally in non-volatile memory in the event of power failure. The memory unit shall be transferrable from a damaged unit or used for a duplicate device with no loss of device parameters or data stored.
 10. The transmitter shall be protected against voltage spikes from the power source with internal transient protection. Power consumption shall be no more than 16 VA, independent of meter size.
 11. The transmitter and sensor shall include a method to verify flow meter performance to the original manufacturer specifications.
 - a. The system shall be traceable to factory calibration using a third party, attested onboard system pursuant to ISO standards.
 - b. The verification technique shall not require external handhelds, interfaces, special tooling or electrical access for a verification to be performed.
 - c. The transmitter shall store up to eight verifications in the microprocessor.
 - d. A verification of the system shall be possible at any time, locally or remotely, on demand and under process conditions.

- e. The verification report shall be compliant to common quality systems such as ISO 9000 to prove reliability of the meter specified accuracy.

2.3 ACCESSORIES

- A. Stainless steel tag - labeled to match the contract documents.
- B. Provide grounding rings, as per manufacture's recommendations, if required
- C. Provide sun shield for outdoor installations as required per the instrument schedule.

2.4 SOURCE QUALITY CONTROL & CALIBRATION

- A. Magnetic flow meters shall be factory calibrated on an ISO-17025 accredited test stand per "General Requirements for the Competence of Testing and Calibration Laboratories" with certified accuracy traceable to NIST.
- B. Evidence of accreditation shall originate from a national verification agency such as A2LA.
- C. Each meter shall ship with a certificate of a 2-point calibration report exceeding stated standard accuracy of 0.5% of rate.
 - 1. Optional calibration to 0.2% of rate shall be performed.
 - 2. An optional performance calibration for a Flat Accuracy Specification shall be performed In the event of low initial design flow rate,.
- D. A real-time computer generated printout of the actual calibration data points shall indicate apparent and actual flows. The flow calibration data shall be confirmed by the manufacturer and shipped with the meters to the project site.
- E. The manufacturer shall provide complete documentation covering the traceability of all calibration instruments.
- F. The manufacturer shall provide ISA data sheet ISA-TR20.00.01 as latest revision of form 20F2321. The manufacturer shall complete the form with all known data and model codes and dash out the inapplicable fields. Incomplete data sheets submitted will result in a rejected submittal.

2.5 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest edition.
- B. All devices shall be certified for use in hazardous areas: Class 1, Div. 2, Groups B/C; temperature rating T3 (200 deg. C)

- C. All devices shall be suitable for use as non-incendive devices when used with appropriate non-incendive associated equipment. Devices with intrinsically safe ratings will normally be acceptable with vendor's approval.
- D. Electrical equipment housing shall conform to NEMA 4X classification.
- E. Non-intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as FM, UL, CSA, etc. for the specified electrical area classification.
- F. Electrical equipment specified as intrinsically safe shall qualify as "simple apparatus" or NRTL approved intrinsically safe equipment per ANSI/ISA-RP12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations," latest edition.
- G. Device failure modes, self-monitoring characteristics and remedy diagnosis shall follow NAMUR standards NE 43 and NE 107

END OF SECTION – 40 71 13

SECTION 43 23 31.23 - PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes high service centrifugal pumps and submersible transfer pumps.
- B. Related Requirements:
 - 1. Section 26 29 23 - Variable-Frequency Motor Drives: Execution and product requirements for equipment specified by this Section.
 - 2. Section 40 05 93 - Common Motor Requirements for Process Equipment: Electric motors and accessories normally supplied as part of equipment assemblies.

1.2 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Approved American National Standard
 - 1. ANSI/HI 9.6.4.5-2000 – Vibration Measurements and Allowable Values
- C. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
- D. ASTM International:
 - 1. ASTM A29 - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 3. ASTM A744 - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
- E. American Water Works Association
 - 1. AWWA E103 – Horizontal and Vertical Line-Shaft Pumps

1.3 COORDINATION

- A. Section 01 40 00 "Quality Requirements".

1.4 SUBMITTALS

- A. Section 01 33 00 "Submittal Procedures": Requirements for submittals.
- B. Section 43 05 20 "Common Work Results for Liquid Handling Equipment": Detailed requirements for pump submittals.
- C. Product Data: Submit manufacturer information for materials of construction and fabrication.
- D. Shop Drawings:
 - 1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
 - 2. Include manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.
 - a. Provide pump and motor, as installed, with no natural frequencies occurring within 25 percent of any exciting frequency for the specified speeds.
 - b. Provide pump and motors that do not exceed the following vibration limits when operating over the range of specified conditions:
 - 1) 0.15 inches per second peak velocity filtered vibration for all frequencies except the pump's blade passing frequency.
 - 2) 0.30 inches per second peak velocity filtered vibration for the pump's blade passing frequency.
- E. Manufacturer's Certificate:
 - 1. Certify that products meet or exceed specified requirements.
 - 2. Certificate of compliance and compatibility for the pumps, motors, and adjustable frequency drives.
- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
- G. Source Quality-Control Submittals: Submit results of factory tests and inspections.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

- I. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 "Closeout Procedures".
- B. Section 01 78 23 "Operation and Maintenance Manuals".
- C. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 SPARE PARTS

- A. Furnish the following spare parts per pump provided:
 1. One set of bearings, if applicable.
 2. One set of O-rings, if applicable.
 3. One set of gaskets for each joint.
 4. One set of mechanical seals.
 5. One year's supply of manufacturer's recommended lubricants.

1.7 WARRANTY

- A. Section 01 77 00 "Closeout Procedures".
- B. The manufacturer is to warranty the equipment supplied to the Owner against defects in material and workmanship for a period of at least one (1) year. Warranty period commences at date of Substantial Completion.

PART 2 - PRODUCTS

2.1 High Service Centrifugal Pumps

- A. Manufacturers:
 1. Gould Pump (Model 3196 STi)
 2. Weinman 1310 Horizontal Split
 3. Or-equal
- B. Description: Process centrifugal pump with close-coupled electric motor rated for inverter duty.
- C. Pump Designation:
 1. HSP-1.

2. HSP-2.

D. Performance and Design Criteria for HSP-1 and HSP-2:

1. Design Flow Rate: 50 gpm each.
2. Design Flow Total Dynamic Head: 225 feet.
3. Minimum Efficiency at Design Flow Rate: 40 percent.
4. NPSH Required: 24 feet maximum.
5. Maximum Motor Speed: 3600 rpm.
6. Suction size: 1.5-inch, or approved equal.
7. Discharge size: 1-inch, or approved equal.
8. Motor Horsepower, max: 15 hp.

2.2 SUBMERSIBLE PUMPS

A. Manufacturers:

1. Crane Pumps & Systems/Barnes (Model SE-421 – 0.4HP)
2. Or-equal

B. Description: Submersible pumps with close-coupled electric motor rated for inverter duty.

C. Pump Designation:

1. Transfer Pump 1
2. Transfer Pump 2

D. Performance and Design Criteria for Transfer Pump 1 and Transfer Pump 2:

1. Design Flow Rate: 50 gpm each.
2. Design Flow Total Dynamic Head: 15 feet.
3. Maximum Motor Speed: 1800 rpm.
4. Suction size: 4-inch, or approved equal.
5. Discharge size: 2-inch, or approved equal.
6. Motor Horsepower, max: 0.4 hp.
7. Voltage and Phase Requirements, min.: 230/1
8. No built-in float switch

E. Casing:

1. Material:
 - a. ASTM A 48, cast iron.
 - b. ASTM A 536, ductile iron.
2. Type: Single volute, double acceptable.
3. Connections: Air vent and drain.
4. Top Portion: Removable, with access to components within casing.
5. End Connections:

- a. Flanged.
 - b. Comply with ASME B16.1, Class 125.
- F. Impeller:
 - 1. Material:
 - a. ASTM A 536, ductile iron.
 - b. ASTM B 584, silicon bronze.
 - c. 316 Stainless Steel.
 - 2. Designed to pump filtered water into a distribution system.
 - 3. Keyed to pump shaft.
 - 4. Statically and dynamically balanced prior to assembly in pump in accordance with ANSI/HI 9.6.4.5-2000, balance grade 6.3.
- G. Shaft:
 - 1. Material:
 - a. ASTM A 29 / A 29M, steel.
 - b. Steel AISI-1040.
 - c. 316 Stainless Steel
 - 2. Key couplings to shaft.
 - 3. Furnish shaft wearing sleeve.
- H. Bearings:
 - 1. Minimum L-10 Life: 100,000 hours at continuous maximum load and speed, according to ABMA 11.
- I. Seals: Component mechanical.
 - 1. Material:
 - a. Teflon
 - b. Carbon-Tungsten Carbide.
 - c. Carbon-Ceramic with Buna Elastomers and Stainless Steel hardware.
 - 2. Provide independently mounted tandem flushless mechanical seals contained in an oil chamber that is formed as an intrinsic part of the bearing frame. Design seals to be completely submerged in and lubricated by the oil bath.
 - 3. Design the upper seal unit between the oil chamber and motor housing of carbon/ceramic faces to isolate the seal cooling oil from the bearing frame.
 - 4. Design the lower seal unit between the pump casing and oil chamber of stainless steel or rubber bellows-type construction, firmly attached to the rotating face and clamped to the shaft to prevent contaminants from contacting the stainless-steel spring which loads the seal face. Furnish seal faces made of solid tungsten-carbide for the rotating face and solid silicon-carbide for the stationary face. Contain lower seal in a seal chamber formed by the impeller flange and a recess cast into the bearing frame.
- J. Lubrication: Grease.

K. Operation:

1. Electrical Characteristics: As specified in Section 26 05 19 "Wire, Cables, and Connectors", 26 29 23 "Variable-Frequency Drives", and following:
 - a. See Part 2 – Products for individual horse-power sizing.
 - b. See electrical sheets for voltage and phase requirements.
2. Motors: As specified in Section 40 05 93 "Common Motor Requirements" for Process Equipment.
3. Controls: As outlined in the Specifications and the Drawings.
4. Operation Sequences: As indicated on Drawings and in the Specifications.

L. Fabrication:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment and to permit removal of pump-rotating assembly and motor without removing piping. Alternately, solid alloy steel pump shaft may be integral to motor.
2. Shaft Guard: Enclose wetted area of shaft with non-ferrous shaft sleeve complying with OSHA standards.
3. Pump and Drive Mating Surfaces: Machine finished.
4. Supports: Pump shall be mounted on heavy duty cast iron support stand or on steel flange supports for floor mounting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps as indicated on Drawings and according to manufacturer instructions.
- B. Provide and connect piping, power, and control conduit, and wiring to make system operational and ready for startup.
- C. Flush piping with clean water.
- D. Installation Standards: Install Work according to Hydraulic Institute standards.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 "Quality Requirements": Requirements for inspecting and testing.
- B. Preoperational Check: Before operating system or components, perform following:
 1. Check pump and motor alignment.
 2. Check for proper motor rotation.

3. Check pump and drive units for proper lubrication.
- C. Startup and Performance Testing:
 1. Operate pump on clear water at design point for continuous period of two hours, under supervision of manufacturer's representative and in presence of Engineer.
 - D. Verify pump performance by performing time-drawdown test or time-fill test.
 - E. Check pump and motor for high bearing temperature and excessive vibration according to manufacturer instructions. Check for motor overload by taking ampere readings.
 - F. Equipment Acceptance:
 1. Adjust, repair, modify, or replace system components that fail to perform as specified and rerun tests.
 2. Make final adjustments to equipment under direction of manufacturer's representative.
- ### 3.3 COATING
- A. Pumps:
 1. Surface Prep: Sandblast pumps to an SSPC-SP 10 Near-White Metal Blast Cleaning standard.
 2. Coating:
 - a. As required by pump manufacturer.

END OF SECTION 43 23 31.23 PUMPS

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