

PROJECT MANUAL

MIDLAND COUNTY
Fairview Cemetery Irrigation
Midland, Texas



MIDLAND COUNTY
TEXAS

November | 2022

Parkhill Project # 034004422

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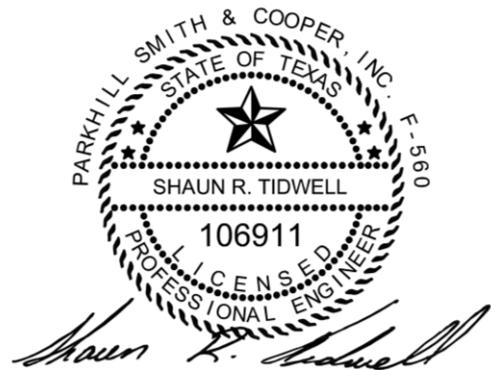
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DESIGN PROFESSIONAL RESPONSIBILITY

Specification Sections authenticated by my seal and signature are limited to:

DIVISION 26 - ELECTRICAL

- 26 05 00 Basic Electrical Methods
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- 26 05 26 Grounding and Bonding
- 26 05 29 Supporting Devices
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- 26 27 26 Wiring Devices
- 26 29 23 Variable Frequency Motor Controllers
- 26 43 00 Surge Protective Devices



11/07/2022

DESIGN PROFESSIONAL RESPONSIBILITY

Specification Sections authenticated by my seal and signature are limited to:

DIVISION 40 – PROCESS INTEGRATION

40 73 29 Differential Pressure Transmitters



**DOCUMENT 00 54 10 - WEATHER TABLE
(MIDLAND, TX)**

The number of calendar days indicated on Document 00 40 00 "Proposal Form" is the Contract time allowed to complete the Project from Notice to Proceed to Substantial Completion, taking into account the normal weather occurrence as shown in the Table below. Weather occurrences exceeding those listed in the table will be taken into consideration when evaluating a request for extension in contract time.

MONTH	MEAN NUMBER DAYS PRECIPITATION (0.01" OR MORE)	NORMAL PRECIPITATION (WATER EQUIVALENT) (INCHES)	MEAN NUMBER DAYS SNOWFALL (INCLUDING ICE PELLETS/SLEET) (1.0" OR MORE)	AVERAGE NUMBER OF DAYS THAT MIN. TEMP IS < 40
JANUARY	2.8	1.28	0	25.6
FEBRUARY	2.6	1.02	0.2	16.8
MARCH	4	1.95	0	4.8
APRIL	3	1.42	0	2
MAY	4.6	2.00	0	0
JUNE	5.2	2.01	0	0
JULY	4	1.47	0	0
AUGUST	5.6	2.06	0	0
SEPTEMBER	6.6	2.38	0	0
OCTOBER	3.8	1.58	0	3.4
NOVEMBER	2	0.89	0	8.6
DECEMBER	3.6	1.16	0	19.8
<u>ANNUALLY</u>	42.5	15.68	1.9	107.4

This table is based on information from NOAA and measured at the Midland International Airport, Midland, Texas.

Means, normals, and averages are based on records covering a period of 5 years from 2016-2020.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Work covered by Contract Documents.
 - 2. Work by Owner or others.
 - 3. Owner-furnished products.
 - 4. Contractor use of site and premises.
 - 5. Owner occupancy.
 - 6. Permits.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Identification: Irrigation at the Cemetery.
- B. Location: Midland, Texas.
- C. Owner: Midland County Fairview Cemetery.
- D. Work consists of New irrigation system for the Midland County Fairview Cemetery.

1.3 WORK BY OWNER OR OTHERS

- A. Owner will award a Contract which commences on a date issued on the Notice to Proceed.
Work under Contract includes:
 - 1. List item(s): Irrigation for the Midland County Fairview Cemetery.
- B. Owner will furnish and install:
 - 1. List item(s): None.

1.4 OWNER-FURNISHED PRODUCTS

- A. Products furnished to site and paid by Owner:
 - 1. List item(s): None.
- B. Owner's responsibilities:
 - 1. Arrange for and deliver to Contractor, Owner-reviewed Shop Drawings, Product Data, and Samples.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturer warranties, inspections, and service.
- C. Contractor's responsibilities:
 - 1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
 - 2. Receive and unload products at site. With Owner, inspect for completeness or damage.
 - 3. Handle, store, and install products.
 - 4. Repair or replace items damaged after receipt.

1.5 CONTRACTOR USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Owner.
 - 3. Public access.
- B. Construction operations: Limited to areas noted on Drawings.
- C. Time restrictions for performing Work:
 - 1. None.
- D. Utility outages and shutdowns.
 - 1. Coordinate and schedule utility outages/shutdown.
 - 2. Schedule at least one week before outage/shutdown.
 - 3. Submit outage/shutdown request to Engineer itemizing dates, times, and durations of early requested outage/shutdown.

1.6 OWNER OCCUPANCY

- A. Owner will occupy premises during construction to conduct normal operations.
- B. Cooperate with Owner to minimize conflict and facilitate Owner operations.

1.7 PERMITS

- A. Furnish all necessary permits for construction of Work including:
 - 1. Building permit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Material allowances.
 - 2. Schedule of Values.
 - 3. Application for Payment.
 - 4. Change Procedures.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 30 00 "Administrative Requirements" for Project information management.
 - 3. Section 01 33 00 "Submittal Procedures" for Schedule of Values.
 - 4. Section 01 60 00 "Product Requirements" for product substitutions.
 - 5.

1.2 SCHEDULE OF VALUES

- A. Submit typed schedule on AIA Form G703 - Application and Certificate for Payment Continuation Sheet.
- B. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed or of Owner-Contractor Agreement, whichever is sooner.
- C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, general conditions, bonds, and insurance as separate line items.
- D. Include within each line item, a directly proportional amount of Contractor's overhead and profit.
- E. Revise schedule to list approved Change Orders, with each Application for Payment.

1.3 APPLICATIONS FOR PAYMENT

- A. Submit notarized application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Payment Period: As defined in Owner-Contractor agreement.
- D. A complete application for payment includes one copy of waiver of liens from each subcontractor, Construction progress schedule, and submittal schedule, all which are required to process the Application for Payment.

1.4 CHANGE PROCEDURES

- A. Architect will advise of minor changes in Work not involving an adjustment to Contract Sum/Price or Contract Time as authorized by Owner/Contractor Agreement by issuing Architect's Supplemental Instructions on Architect's Standard Supplemental Instruction form.

- B. Architect may issue a Construction Change Request which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications and a change in Contract Time for executing change. Contractor will prepare and submit an estimate within seven days.
- C. Contractor may propose a change by submitting request for change to Architect. Include reason for change and effect on Contract Sum/Price, Contract Time, and subcontractors. Document requested substitutions in accordance with Section 01 60 00 01 60 00 Requirements."
- D. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by Architect.
- E. Construction Change Directive: Architect may issue a directive, on AIA Form G713 Construction Change Directive signed by Owner, instructing Contractor to proceed with a change in Work, for subsequent inclusion in a Change Order. Document will describe changes in Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- F. Time and Material Change Order:
 - 1. Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract.
 - 2. Architect will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
 - 3. Maintain detailed records of work done on Time and Material basis.
 - 4. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in Work.
- G. Change Order Forms: AIA G701 Change Order.
- H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- I. Change Order: Furnish an itemized breakdown, in form acceptable to Architect of costs and supporting information including but not limited to quantities and material prices. Tier subcontracted work performed at labor rates, employer payments, and rental rates. Itemize breakdown detail shall be same for subcontractor work. Provide complete supporting information for profit and overhead or markups used when requested. Consider the following items a part of overhead or Contractor's and subcontractor's mark-up and do not include as separate cost item: Labor for Superintendents, Assistant Superintendents, home office personnel, timekeepers, and maintenance mechanics at any level of contracting; individual pieces of equipment, hand tools or instruments having a new value of \$500.00 or less, whether or not consumed by use; on site and main offices; modification to record Contract Documents; nor guarantee period costs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project Information Management.
 - 2. Coordination.
 - 3. Electronic drawing file (digital data) request.
 - 4. Submittal schedule.
 - 5. Preconstruction meeting.
 - 6. Request for information.
 - 7. Site mobilization meeting.
 - 8. Progress meetings.
 - 9. Preinstallation meetings.
 - 10. Cutting and patching.
 - 11. Alteration Project procedures.
- B. Related Sections:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.

1.2 PROJECT INFORMATION MANAGEMENT

- A. Project Website:
 - 1. Use Newforma Info Exchange; <https://projects.team-psc.com/UserWeb/Login> to send and receive Project information.
 - 2. Contact Architect to set up name and password information.
 - 3. If this Project is not listed when logged in, contact Architect to add to your account.
- B. Project information includes, but is not limited to, the following:
 - 1. Product Submittals.
 - 2. Requests for Information (RFI).
 - 3. Applications for Payment.
 - 4. Schedules.
 - 5. Construction Change Requests (CCRs).
 - 6. Closeout Documents.
 - 7. Construction Document Files.
 - a. Weather Days.
 - b. Electronic File Requests.
 - c. Correspondence.
 - d. Test Reports.
 - e. Meeting Minutes.
 - f. Field Reports.

1.3 COORDINATION

- A. Coordinate scheduling, submittals, and Work to assure efficient and orderly sequence of installation of construction elements.

- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion.

1.4 ELECTRONIC DRAWING FILE (DIGITAL DATA) REQUEST

- A. During Procurement Phase:
 - 1. Bidders and Proposers may purchase a Digital Data file. Digital Data file will be provided in software release currently used by Architect. File will be provided via Architect's Project website.
 - 2. AutoCAD drawing files (.dwg) are available for purchase from Architect upon request. Cost of files are indicated below plus applicable tax.
 - a. 1 - 3 Sheets: \$100.00 per sheet.
 - b. 4 - 6 Sheets: \$400.00 flat fee.
 - c. 7 - 9 Sheets: \$500.00 flat fee.
 - 3. Revit® BIM Model files (.rvt) are available for purchase from Architect upon request. Cost of model files are \$150.00 for each model plus applicable tax. All details, detail annotation, and references are omitted and not part of the Model file.
 - 4. Prior to delivery of file(s), purchaser shall sign a Digital Data Licensing Agreement. Payment for Digital Data file(s) shall occur upon delivery of file to purchaser.
 - 5. Digital Data file(s) shall be used only for preparing Bids and Proposals required by this Project and shall not be used in any other form, in whole or in part.
- B. Upon Award of Contract:
 - 1. At the pre-construction meeting, Contractor shall bring the executed Digital Data Licensing Agreement (AIA C106-2013) at the end of this Section for the release of electronic files. Upon Contractor submitting the executed Agreement to the Architect, the Architect will provide the Contractor one (1) electronic copy of the Revit®BIM Model file(s), AutoCAD (.dwg) file(s), when Revit®BIM Model file is not available, and Portable Document Format (.pdf) file(s) at no charge within five (5) working days. Note that CAD files associated with the work can be accessed and exported from the Revit®BIM Model provided to the Contractor through the use of Revit®software; therefore, individual CAD files will not be provided by the Architect.
 - 2. The Revit®BIM Model file provided to the Contractor is NOT FOR CONSTRUCTION PURPOSES, but for convenience only. This BIM Model will consist of the original model utilized for Base Bid. It is the responsibility of the Contractor to coordinate all accepted Alternates, Addenda, Request for Information, Proposal Requests, and any other changes realized during the procurement and construction phases. The Architect will not provide up-to-date Contract Documents or updated BIM Models to the Contractor unless otherwise stated within the Owner/Architect Agreement.

3. Conformed Construction Documents: If Conformed Construction Documents are required by the Owner/Architect Agreement, they will be provided in PDF. Conformed Construction Documents are the Drawings and Specifications modified to include any Addenda issued before execution of the Contract.
 - a. To the extent Conformed Construction Documents are provided to the Contractor, the following provisions shall apply:
 - 1) The Conformed Construction Documents and related information contained therein, are provided for Contractor's convenience only, and does not relieve the Contractor from the requirements of the Contract Documents. Specifically, to the extent that any discrepancy or conflict exists between the Issue for Bid Documents, including any Addenda issued prior to execution of the Contract or Modifications issued after the execution of the Contract on the one hand, and the Conformed Construction Documents on the other; the Issue for Bid Documents, Addenda, and Modifications shall control unless otherwise specified in writing by the Architect.
 - 2) Contractor shall not use such Drawings, Documents, or other data, in whole or in part, for any purpose or project other than this Project in the preparation of Shop Drawings and other submittals.
 - 3) Contractor acknowledges that such Drawings, Documents, and other data are subject to change or modification. Contractor shall be responsible for updating any Drawings, Documents, or other data obtained prior to use by them for any purpose.
 - 4) Any Conformed Construction Documents, including any Drawings, Specifications, documents, or other data related thereto are provided "as is" without representation or warranty by Architect, either expressed or implied.
 - 5) Contractor acknowledges that Conformed Construction Documents provided by Architect are as a courtesy to Contractor, at their specific request, and accordingly, CONTRACTOR HEREBY AGREES TO RELEASE, HOLD HARMLESS, DEFEND AND INDEMNIFY ARCHITECT AND OWNER FROM ANY AND ALL CLAIMS, DEMANDS, OR CAUSES OF ACTION, WHICH CONTRACTOR OR ANY THIRD PARTY MAY HAVE BY REASON OF ANY INJURY OR DAMAGE SUSTAINED BY CONTRACTOR OR THIRD PARTY ARISING OUT OF OR IN ANY WAY RELATED TO THE USE OF SUCH CONFORMED CONSTRUCTION DOCUMENTS.

1.5 SUBMITTAL SCHEDULE

- A. Prepare submittal schedule in accordance with General Conditions of the Contract for Construction.
- B. Include in submittal schedule all submittals and samples required by all section of this Project Manual and any additional submittals required by the Contractor to construct the Project.
- C. Submit submittal schedule for Architect's review within 15 days after date established in Notice to Proceed or with the first Application for Payment, whichever is sooner. Failure to submit submittal schedule with the first Application for Payment will be cause for not processing Application for Payment.

1.6 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice to Proceed.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Major subcontractors.
- C. Agenda:
 - 1. Submission of executed bonds and insurance certificates.
 - 2. Distribution of Contract Documents.
 - 3. Submission of list of subcontractors, list of products, Schedule of Values, submittal schedule, and progress schedule.
 - 4. Designation of personnel representing each party in Contract and Architect.
 - 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, Request for Information (RFI), and Contract closeout procedures.
 - 6. Review Notice to Proceed (NTP) and Substantial Completion Dates.
 - 7. Scheduling:
 - a. Use of premises by Owner and Contractor.
 - b. Owner's requirements and partial occupancy.
 - c. Construction facilities and controls provided by Owner.
 - d. Temporary utilities provided by Owner.
 - e. Survey and building layout.
 - f. Security and housekeeping procedures.
 - g. Construction progress meetings.
 - h. Procedures for testing.
 - i. Procedures for maintaining record documents.
 - j. Requirements for start-up of equipment.
 - k. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within three days after meeting to participants with two copies to Architect and those affected by decisions made.

1.7 REQUEST FOR INFORMATION

- A. Request for information (RFI) requests from subcontractors or material suppliers will not be considered. All RFI's must be submitted by Contractor.
- B. RFI's must be submitted to Architect via software as indicated in paragraph 1.2.A
- C. Information indicated on RFI shall be complete before submission. If Architect determines that request can be answered with information provided, Architect will assign an RFI tracking number. Requests determined by Architect not to be an RFI will be returned to Contractor electronically and deleted from Architect's electronic tracking software without being assigned an RFI tracking number. A transmittal document returning the denied RFI request will be provided with a response indicating action to be taken by Contractor.
- D. RFIs may contain more than one item when items are related issues. Otherwise, only one item shall be addressed on each RFI request.
- E. Allow seven (7) days for Architect's response to each RFI.

- F. Response to RFI will be issued to Contractor and Owner per Section 01 33 00 "Submittal Procedures."
- G. Responses from Architect are not changes unless issued with a change per Section 01 20 00 "Price and Payment Procedures."

1.8 SITE MOBILIZATION MEETING

- A. Architect will schedule a meeting at site prior to Contractor occupancy.
- B. Attendance Required: Architect, special consultants, Contractor, Contractor's superintendent, and major subcontractors.
- C. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements and partial occupancy.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Procedures for testing.
 - 9. Procedures for maintaining record documents.
 - 10. Requirements for start-up of equipment.
 - 11. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within three days after meeting to participants with copies to those affected by decisions made.

1.9 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of Work at minimum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required:
 - 1. Owner.
 - 2. Job superintendent.
 - 3. Major subcontractors.
 - 4. Suppliers.
 - 5. Architect.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems which impede planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of off-site fabrication and delivery schedules.
 - 7. Maintenance of progress schedule.
 - 8. Corrective measures to regain projected schedules.
 - 9. Planned progress during succeeding work period.

10. Coordination of projected progress.
 11. Maintenance of quality and work standards.
 12. Effect of proposed changes on progress schedule and coordination.
 13. Other business relating to Work.
- E. Record minutes, and distribute copies within three days to Architect, participants, and those affected by decisions made.

1.10 PREINSTALLATION MEETING

- A. When required in individual specification Sections, convene a preinstallation meeting at site prior to installing Work.
- B. Require attendance of parties directly affecting, or affected by, Work.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting.
 1. Review conditions of installation, preparation and installation procedures.
 2. Review coordination with related work.
- E. Record minutes, and distribute copies within three days after meeting to participants, with three copies to Architect.

PART 2 - PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Motors: Specific motor type is specified in individual Specification Sections.
- B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.
- C. Cord and Plug: Provide minimum 6-foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available, of correct characteristics, and in correct location.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply any manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit request in advance of cutting or altering elements which affects:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.
- E. Cut rigid materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection. For an assembly, refinish entire unit.
- J. Identify any hazardous substance or condition exposed during Work to Architect for decision or remedy.

3.4 ALTERATION PROJECT PROCEDURES

- A. Materials: As specified in product Sections; match existing products and work for patching and extending work.
- B. Employ skilled and experienced installer to perform cutting and patching.
- C. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- D. Remove, cut, and patch work in a manner to minimize damage and to provide a means of restoring products and finishes to original condition unless otherwise specified.
- E. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
- F. Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance.
- G. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Architect for review.

- H. Where a change of plane of 1/4-inch or more occurs, submit recommendation for providing a smooth transition for Architect review.
- I. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- J. Finish surfaces as specified in individual product Sections.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal procedures.
 - 2. Resubmittal requirements.
 - 3. Construction progress schedules.
 - 4. Proposed products list.
 - 5. Shop drawings.
 - 6. Product data.
 - 7. Samples.
 - 8. Design data.
 - 9. Test reports.
 - 10. Certificates.
 - 11. Manufacturers' instructions.
 - 12. Manufacturers' field reports.
 - 13. Construction photographs.
 - 14. Coordination and interference BIM model.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 20 00 "Price and Payment Procedures" for Schedule of Values; Inspecting and Testing Allowances.
 - 3. Section 01 30 00 "Administrative Requirements" for Project information management.
 - 4. Section 01 40 00 "Quality Requirements" for manufacturers' field services and reports; Testing Laboratory Services.
 - 5. Section 01 70 00 "Execution and Closeout Requirements" for Contract warranty, manufacturer's certificates, and closeout submittals.

1.2 SUBMITTAL PROCEDURES

- A. Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Produce copies and distribute in accordance with this Article.
- C. Use Project website to submit record documents as described in Section 01 70 00 "Execution and Closeout Requirements."
- D. Transmit each submittal separately with Contractor's standard transmittal letter including Contractor's name, address, and phone number. Each submittal shall contain only one Specification Section.
- E. Sequentially number transmittal forms using Section number or Contractors other sequential numbering system.
- F. Identify Project, Contractor, subcontractor, or supplier; pertinent Drawing Sheet and detail number(s), and Specification Section number appropriate to submittal.

- G. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with requirements of Work and Contract Documents.
- H. Schedule submittals to expedite Project, and deliver to Architect. Coordinate submission of related items.
- I. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- J. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work. Information, comments, field verifications, responses, or other notations marked on submittals by Contractor shall be done in blue or green colors only.
- K. Allow space on submittals for Contractor and Architect's review stamps.
- L. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- M. Submittals not requested will not be recognized or processed.
- N. Format:
 - 1. Submit all submittals digitally using .PDF file extension. Each submittal shall be a single .PDF file including transmittal letter. Multiple files for same submittal will not be accepted.
 - 2. Submittals in any other format, including .ZIP files, will be rejected.
 - 3. Hard copies will not be accepted.
 - 4. To ensure each page is legible, .PDF pages of drawings shall be same size/scale as a hard copy. Where applicable, scale symbols should be provided to indicate scale. Illegible submittals will be rejected.
 - 5. Uploaded submittals to Project website.
- O. Submittal procedures described in this Article applies to construction progress schedule, products list, shop drawings, product data, samples (actual samples and digital files of same), design data, test reports, certificates, manufacturer's instructions and field reports, erection drawings, and any other type of submittal submitted to Architect.

1.3 RESUBMITTAL REQUIREMENTS

- A. Revise and resubmit submittals, as required, and resubmit to meet requirements as specified and as noted on submittal reviews.
- B. Mark as RESUBMITTAL.
- C. Re-use original transmittal number and supplement with sequential alphabetical or numeric suffix for each re-submittal.

1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule for Architect's review within 15 days after date established in Notice to Proceed or with the first Application for Payment, whichever is sooner.
- B. Revise and resubmit as required.
- C. Submit revised schedule with each Application for Payment, identifying changes since previous version.
- D. Submit a horizontal bar chart with separate line for each section of Work, identifying first work day of each week.
- E. Indicate product/material manufacturer's lead-time for delivery to site. Include as a separate line for each product/material.
- F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes. Submit separate schedule of submittal dates for following:
 - 1. Shop drawings.
 - 2. Product data.
 - 3. Samples.
 - 4. Owner furnished products.
 - 5. Products identified under Allowances.
- I. Determine appropriate lead times to allow for manufacturing and delivery of products/material for incorporation into Work. Indicate product/material manufacturer's lead-time for manufacturing and delivery to site. Include as a separate line for each product/material. Failure to timely submit and process submittals, and ordering of products/materials for delivery to site will not be grounds for approval of substitutions for other products/materials.
- J. Revisions to Schedules:
 - 1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
 - 2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
 - 3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

1.5 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6 SHOP DRAWINGS

- A. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- B. Printable Image Size: Minimum 8-1/2 by 11 inches and maximum 30 by 42 inches.
- C. Draw details to a minimum scale of 1/2-inch equal to 1 foot.
- D. Draw site plans to same scale indicated on Contract Drawings.
- E. Draw other plans to a minimum scale of 1/8-inch equal to 1 foot.
- F. Construction Documents (electronic or paper format) issued by Architect cannot be used in any shape, form, or fashion in creation and development of Shop Drawings, except that electronic files containing floor plans or site plans which have been acquired from Architect may be used as backgrounds for Contractor, subcontractors, sub-subcontractors, and material suppliers in shop drawing process.
- G. In creation and publication of Shop Drawings, under no circumstances shall Architect's seal or title block of Drawing be reproduced. Shop Drawings must be original works from Contractor, subcontractors, sub-subcontractors, and material suppliers.

1.7 PRODUCT DATA

- A. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.

- B. Include recommendations for application and use, and reference to compliance with specified standards of trade associations and testing agencies.
- C. Include notation of special coordination requirements for interfacing with adjacent work and building utilities where applicable.
- D. After review, distribute in accordance with "Submittal Procedures" Article above and provide copies for Record Documents described in Section 01 70 00 "Execution and Closeout Requirements."

1.8 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of product, with integral parts and attachment devices. Accompany physical sample with color digital image (photo or scanned .PDF) of sample. Coordinate sample submittals for interfacing work.
- B. Unless otherwise specified, submit samples of finishes from manufacturers' full range of standard colors, textures, and patterns, for Architect's selection.
- C. Where variations in color, pattern, or texture are inherent in material or product, submit multiple samples to indicate approximate range or variations.
- D. Include full Project information and identification of manufacturer, model number, type, style and color on each sample.
- E. Submit number of samples specified in individual Specification Sections; one of which will be retained by Architect.
- F. Reviewed samples which may remain as part of Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in individual Specification Sections.

1.9 DESIGN DATA

- A. Submit for Architect's knowledge as Contract Administrator or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 TEST REPORTS

- A. Submit for Architect's knowledge as Contract Administrator or for Owner.
- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.11 CERTIFICATES

- A. When specified in individual Specification Sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

1.12 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual Specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing.

- B. Identify conflicts between manufacturers' instructions and Contract Documents.
- C. Indicate special procedures, conditions requiring special attention and special environmental criteria required for application or installation.

1.13 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect's benefit as Contract Administrator or for Owner.
- B. Submit report within 30 days of observation to Architect for information.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quality control and control of installation.
 - 2. Tolerances.
 - 3. References.
 - 4. Testing and Inspection services.
 - 5. Manufacturers' field services.
 - 6. Examination.
 - 7. Preparation.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 30 00 "Administrative Requirements" for Project information management.
 - 3. Section 01 33 00 "Submittal Procedures" for submission of manufacturers' instructions and certificates.
 - 4. Section 01 60 00 "Product Requirements" for requirements for material and product quality.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as a minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce workmanship of specified quality.
- F. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Notice to Proceed, except where a specific date is established by Code.
- C. Obtain copy of standards when required by Specification Section.
- D. Neither contractual relationship, duties, nor responsibilities of parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.5 TESTING AND INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection and testing.
- B. The independent firm will perform inspections, tests, and other services specified in individual Specification Sections and as required by Architect.
- C. Testing, inspections and source quality control may occur on or off Project site. Perform off-site testing as required by Architect or Owner.
- D. Submit independent testing laboratory firm's reports to Architect. Reports to include observations and results of tests and will indicate compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, provide safe access to Project site, and provide assistance by incidental labor as requested.
 - 1. Notify Architect and independent firm 48 hours prior to expected time for operations requiring services.
 - 2. Pay for additional samples and tests required for Contractor's use.
- F. Employment of independent testing agency or laboratory does not relieve Contractor from performing Work to Contract requirements.
- G. Re-testing and/or re-inspection required because of non-conformance to specified requirements will be charged to Contractor by deducting re-testing and/or re-inspection charges from Contract Sum/Price.

1.6 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, and startup of equipment, as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations. Observer subject to approval of Architect.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00 "Submittal Procedures," "Manufacturer's Field Reports" Article.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Examine and verify specific conditions described in individual Specification Sections.
- C. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Temporary Utilities:
 - a. Electricity.
 - b. Water.
 - c. Sanitary.
 - 2. Construction Facilities:
 - a. Field offices and sheds.
 - b. Vehicular access.
 - c. Parking.
 - d. Progress cleaning.
 - e. Project identification.
 - f. Traffic regulation.
 - 3. Temporary Controls:
 - a. Barriers.
 - b. Fencing.
 - c. Enclosures.
 - d. Water control.
 - e. Dust control.
 - f. Erosion and sediment control.
 - g. Noise control.
 - 4. Removal of utilities, facilities, and controls.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 70 00 "Execution and Closeout Requirements" for final cleaning.

1.2 TEMPORARY ELECTRICITY

- A. Connect to existing power service. Power consumption shall not disrupt Owner's need for continuous service.
- B. Owner will pay cost of energy used. Exercise measures to conserve energy.

1.3 TEMPORARY WATER SERVICE

- A. Connect to existing water source for construction operations. Extend and supplement with temporary devices as needed to maintain specified conditions for construction operations.
- B. Owner will pay cost of water used.
- C. Exercise measures to conserve water.
- D. Provide temporary pipe insulation to prevent freezing.

1.4 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures.
- B. Existing facilities shall not be used.

1.5 FIELD OFFICES AND SHEDS

- A. Do not use existing facilities for field offices or for storage.

1.6 EMPLOYEE RESIDENTIAL OCCUPANCY

- A. Not allowed on Owner's property.

1.7 VEHICULAR ACCESS

- A. Location as approved by Architect .
- B. Use existing on-site roads for construction traffic .
- C. Provide vehicular access to all existing roads during construction. All paving cuts, shall be open for vehicular traffic within 24 hours of demolition.

1.8 PARKING

- A. Use of existing on-site streets and driveways for construction traffic is permitted.
- B. Do not allow heavy or tracked vehicles or construction equipment in parking areas.
- C. Permanent Pavements and Parking Facilities:
 - 1. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
 - 2. Use of permanent parking structures is permitted.
- D. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
 - 2. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.
- E. Removal, Repair:
 - 1. Repair existing facilities damaged by use, to original condition.
- F. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.9 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Remove waste materials, debris, and rubbish from site and dispose off-site at intervals as required to maintain clean site.

1.10 PROJECT IDENTIFICATION

- A. Project Identification Sign:
 - 1. Size: Provide one 8 feet wide by 4 feet high.
 - 2. Materials: 3/4-inch-thick exterior grade plywood and solid wood frame.
 - 3. Background Paint: Exterior quality, two coats; sign background of color as selected.
 - 4. Design: Design indicated in Drawings.
- B. Design sign and structure to withstand 90 miles/hr wind velocity.

- C. Installation:
 - 1. Install Project identification sign within 15 days after date fixed by Notice to Proceed.
 - 2. Erect at location directed by Architect.
 - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
 - 4. Install sign surface plumb and level, with butt joints. Anchor securely.
 - 5. Paint exposed surfaces of sign supports and framing.
- D. No other signs are allowed without Owner's permission except those required by law.
- E. Maintenance: Maintain signs and supports clean, repair deterioration and damage.
- F. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

1.11 TRAFFIC REGULATION

- A. Signs, Signals, and Devices:
 - 1. Traffic Cones and Drums: As approved by authority having jurisdiction.
- B. Traffic Signs and Signals:
 - 1. Provide signs at approaches to site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
 - 2. Relocate as Work progresses, to maintain effective traffic control.
- C. Removal:
 - 1. Remove equipment and devices when no longer required.
 - 2. Repair damage caused by installation.

1.12 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
 - 1. Allow for Owner's use of site.
- B. Provide protection for the following items designated to remain. Replace damaged items condition to original condition.
 - 1. Trees.
 - 2. Shrubbery.
 - 3. Lawns.
- C. Protect site improvements including but not limited to pavements, walkways, and drainage structures from damage. Replace damaged site improvements to original condition.

1.13 TEMPORARY FENCING

- A. Construction: Plastic construction netting.
- B. Provide 6-foot-high fence around temporary materials storage area; equip with vehicular gates with locks as required.

1.14 WATER CONTROL

- A. Maintain excavations free of water.

1.15 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.16 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize surface area of bare soil exposed at one time.
- C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow that would result in erosion.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.17 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above grade utilities, equipment, facilities, and materials as soon as permanent facilities can be utilized.
- B. Remove risers for underground utilities to a minimum depth of 2 feet and cap.
- C. Remove buried equipment, facilities, and materials completely to a minimum depth of 2 feet and cap.
- D. Backfill excavations as specified in other sections and grade site as indicated.
- E. Clean and repair damage caused by installation or use of temporary work.
- F. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
 - 1. Section 01 50 00 "Temporary Facilities and Controls" for temporary site fencing.

1.2 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
- B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
 - b. Quality-control program.
 - c. Coordination of Work and equipment movement with the locations of protection zones.
 - d. Trenching by hand or with air spade within protection zones.
 - e. Field quality control.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
 - 2. Detail fabrication and assembly of protection-zone fencing and signage.
 - 3. Indicate extent of trenching by hand or with air spade within protection zones.

- C. Samples: For each type of the following:
 - 1. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
 - 2. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- E. Quality-control program.

1.6 QUALITY ASSURANCE

- A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- B. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Moving or parking vehicles or equipment.
 - 3. Foot traffic.

4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: Shredded hardwood.
 2. Size Range: 3 inches maximum, 1/2-inch minimum.
 3. Color: Natural.
- B. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.
1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft. remaining flexible from minus 60 to plus 200 degrees F; inert to most chemicals and acids; minimum tensile yield strength of 2,000 psi and ultimate tensile strength of 2,680 psi; secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.
 - a. Height: 48 inches.
 - b. Color: High-visibility orange, nonfading.
 2. Gates: Single-swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 24 inches as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.2 PREPARATION

- A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
1. Install temporary root protection matting over mulch to the extent indicated.

3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
- B. Maintain protection zones free of weeds and trash.
- C. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 20 00 "Earth Moving" unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.

2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 3. Cover exposed roots with burlap and water regularly.
 4. Backfill as soon as possible according to requirements in Section 31 20 00 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.7 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
1. Submit details of proposed pruning and repairs.
 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
 2. Large Trees: Provide one new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
 - a. Species: As selected by Architect.
 3. Plant and maintain new trees as specified.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Products.
 - 2. Product delivery, storage, and handling.
 - 3. Product options.
 - 4. Substitutions.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 30 00 "Administrative Requirements" for Project information management.
 - 3. Section 01 40 00 "Quality Requirements" for product quality monitoring.

1.2 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming Work and does not include machinery and equipment used for preparation, fabrication, conveying and erection of Work.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Provide interchangeable components of same manufacturer, for similar components.
- D. Materials required to match existing work and not otherwise specified, shall be equal to existing work in quality, color, and finish. Workmanship and installation shall be comparable to adjacent existing work. Architect shall be authority in determination of acceptable work.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials, products, and equipment to site in manufacturer's original, unopened containers or packaging, with identifying labels intact and legible.
 - 2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
 - 3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
 - 4. Arrange deliveries in accord with construction schedule and in ample time to facilitate inspection prior to installation to avoid unnecessary delays in construction process.
- B. Storage:
 - 1. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible.
 - 2. Store sensitive products in weathertight, climate-controlled enclosures.
 - 3. For exterior storage of fabricated products, place on supports, above ground, sloped to drain water.

4. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of products.
 5. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 6. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
 7. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
 8. Materials, products, and equipment may be stored off site in a bonded and insured warehouse approved by Architect and Owner. Pay all costs incurred for off-site storage facilities. Products properly stored in off-site storage facilities may be included in progress pay requests with written approval of Architect.
- C. Handling: Handle materials, products, and equipment in a manner prescribed by manufacturer or specified to protect from damage during storage and installation.

1.4 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named in accordance with this Section.

1.5 SUBSTITUTIONS

- A. Instructions to Proposers specify time restrictions for submitting requests for Substitutions during proposal period to requirements specified in this Section.
- B. Architect will consider requests for substitutions within 15 days after date established in Notice to Proceed.
- C. Substitutions (after proposal period) may be considered when a product becomes unavailable through no fault of Contractor.
- D. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- E. A request constitutes a representation that Proposer:
 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product.
 3. Will coordinate installation and make changes to other Work which may be required for Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- G. Substitution Submittal Procedure:
 1. Submit request for Substitution for consideration. Limit each request to one proposed Substitution.

2. Requests shall include name of material or equipment to be substituted and a description of proposed substitution including drawings, performance and test data, and other information necessary for an evaluation.
3. Submit item-by-item (line-by-line) comparison of each item listed in Specification compiled and submitted comparing specified material/product with proposed substitution and specifically noting all differences between the compared products and/or systems.
4. Submit statement setting forth changes in other material, equipment or other portions of Work including changes in work of other contracts that incorporation of proposed substitution would require shall be included.
5. Submit shop drawings, product data, and certified test results for proposed product equivalence.
6. Architect will notify Contractor, in writing, of decision to accept or reject request.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Closeout procedures.
 - 2. Final cleaning.
 - 3. Starting of systems.
 - 4. Demonstration and instructions.
 - 5. Protecting installed construction.
 - 6. Project record documents.
 - 7. Operation and maintenance data.
 - 8. Manual for materials and finishes.
 - 9. Manual for equipment and systems.
 - 10. Spare parts and maintenance products.
 - 11. Product warranties and product bonds.
 - 12. Maintenance service.
- B. Related Requirements:
 - 1. Other Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 30 00 "Administrative Requirements" for Project information management.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's review.
- B. Provide submittals to Architect required by authority having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Closeout documents will be submitted electronically in OCR (Optical Character Recognition)/PDF format.
- E. At Owner's request, Contractor shall provide a hard copy of Closeout Documents in three-ring binders.
- F. Owner will occupy portions of site as specified in Section 01 10 00 "Summary."

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
- B. Clean site; sweep paved areas, rake clean landscaped surfaces.
- C. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Architect days prior to startup of each item.

- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of applicable Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to startup, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 33 00 "Submittal Procedures" that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain aspects of operation and maintenance.
- C. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- E. Required instruction time for each item of equipment and system is specified in individual Sections.

1.6 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Prohibit traffic from landscaped areas.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of record documents; record actual revisions to Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Complete set of MSDS sheets for materials.
 - 7. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.

- E. Specifications: Legibly mark and record at each product Section description of products installed, including following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda, Change Orders, RFI responses, and other modifications. For Addenda, Change Orders, and RFI responses, cut out and tape to pages in appropriate location, referencing source of change.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of Work.
 - 3. Field changes of dimension and detail.
 - 4. Details not on original Contract Drawings.
 - 5. Changes made by Addenda, Change Order, RFI responses, and other modifications. For Addenda, Change Orders, and RFI responses, cut out and tape to pages in appropriate location, referencing source of change.
 - 6. Submit in OCR (Optical Character Recognition)/PDF format.
 - 7. Submit MSDS on products used in construction of Project.
 - 8. Submit MSDS electronically in 8-1/2- x 11-inch format text pages.
 - 9. Prepare cover page with printed title "MATERIAL SAFETY DATA SHEETS (MSDS)," Title of Project, Project Address, Owner's Name, Address and Phone, and Date of Construction Completion.
 - 10. Internally subdivide contents with page dividers, organized into CSI format shown in Project Manual.
 - 11. Prepare a table of contents, listing each of Division headings and listing each material/product under each heading by manufacturer and material/product name.
 - 12. Submit complete set of aforementioned information in OCR (Optical Character Recognition)/PDF format.
 - 13. Submit information with Application for Final Payment and include MSDS for materials/products delivered or installed in Project.
 - 14. Failure to submit updated electronic MSDS documents will cause Application for Final Payment to be held by Architect (not submitted to Owner for processing) until such time updated electronic MSDS documents are received and reviewed for compliance by Architect.
- G. Submit documents to Architect with claim for final Application for Payment.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit data electronically in 8-1/2- x 11-inch text pages, OCR (Optical Character Recognition)/PDF format.
- B. Prepare cover page with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project.
- C. Internally subdivide contents with page dividers, logically organized as described below:
 - 1. Drawings: Provide in OCR (Optical Character Recognition)/PDF format.
 - 2. Contents: Prepare Table of Contents for each file (if multiple files), with each product or system description identified, in three parts as follows:
 - a. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, subcontractors, and major equipment suppliers.

- b. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify:
 - 1) Significant design criteria.
 - 2) List of equipment.
 - 3) Parts list for each component.
 - 4) Operating instructions.
 - 5) Maintenance instructions for equipment and systems.
- c. Part 3: Project documents and certificates, including:
 - 1) Shop drawings and product data.
 - 2) Certificates.
 - 3) Scanned copies of warranties and bonds in OCR (Optical Character Recognition)/PDF format.
- D. Submit one complete set of aforementioned information in OCR (Optical Character Recognition)/PDF format.
- E. Submit documents with Application for Final Payment.

1.9 MANUAL FOR MATERIALS AND FINISHES

- A. Submit in OCR (Optical Character Recognition)/PDF format of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return electronic file with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within 10 days after acceptance.
- C. Submit one electronic copy of completed volumes 15 days prior to final inspection. Draft copy to be reviewed and returned , with Architect comments. Revise content of electronic document set as required prior to final submission.
- D. Submit electronic documents of revised final volumes in final form within 10 days after final inspection.
- E. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- F. Additional Requirements: As specified in individual product Specification Sections.
- G. Include listing in Table of Contents for design data, with fly sheet.

1.10 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit in OCR (Optical Character Recognition)/PDF format of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit electronic documents within 10 days after acceptance.
- C. Submit electronic copy of completed volume(s) 15 days prior to final inspection. Draft copy to be reviewed and returned, with Architect comments. Revise content of electronic document set as required prior to final submission.
- D. Submit electronic documents in OCR (Optical Character Recognition)/PDF format of revised final volumes in final form within 10 days after final inspection.
- E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

- F. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.
- G. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- H. Include servicing and lubrication schedule, and list of lubricants required.
- I. Include manufacturer's printed operation and maintenance instructions.
- J. Include sequence of operation by controls manufacturer.
- K. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- L. Include control diagrams by controls manufacturer as installed.
- M. Include Contractor's coordination drawings, with color coded piping diagrams as installed.
- N. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- O. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- P. Additional Requirements: As specified in individual product Specification Sections.
- Q. Include listing in Table of Contents for design data, with dividers.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.
- B. Deliver to Project site; obtain receipt prior to final payment.
- C. Submit receipts signed by Owner or letter stating Contractor has delivered extra products to Owner.

1.12 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents.
- F. Submit one complete set of aforementioned information in OCR (Optical Character Recognition)/PDF format for review.
- G. Submit prior to Application for Final Payment.
- H. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.13 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in Specification Sections .
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 3. Section 01 73 00 "Execution" for cutting and patching procedures.

1.2 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.

1.3 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.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 4. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Predemolition Photographs or Video: Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials 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.

1.8 WARRANTY

- A. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

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 Architect.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 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. Disconnect, demolish, and remove equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - c. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

3.3 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. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

3.4 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. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
 - 1. Store items in a secure area until delivery to Owner.
 - 2. Transport items to Owner's storage area on-site.
 - 3. Protect items from damage during transport and storage.
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition, and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4-inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Asphalt paving: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be 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.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.

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.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Construction to Be Removed: Remove existing concrete and asphalt paving as required for new construction.
- B. Existing Items to Be Removed and Salvaged: Remove existing irrigation heads, valves, and above grade aluminum pipe fittings and return to Owner.
- C. Existing Items to Remain: All existing grave markers, signage, landscape plantings, and paving shall remain.

END OF SECTION

SECTION 26 05 00 - BASIC ELECTRICAL METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 REQUIREMENTS

- A. Requirements of General Conditions, Special Conditions, and these Specifications are applicable and part of every Section in Division 26 - Electrical. Contractor shall furnish all labor, material, service, equipment, appliances, and perform all operations in connection with installation and testing of Electrical Work per Contract Drawings and Specifications. Engineer will reject any material found defective and Contractor shall remove defective material from Work site.
- B. Contractor is responsible for all material they furnish and shall replace, at own expense, all materials found defective in manufacture or damaged after delivery.
- C. Interconnections between various items of electrical equipment and control system will likely require coordination and in some cases, interface devices such as but not limited to couplings, flanges, reducers, converters, conduit, relays, terminal blocks, contacts, wiring etc., will be required whether or not these items are shown on Drawings. It is the General Contractor's responsibility to provide necessary coordination and interface devices at no additional cost to Owner.

1.3 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

- A. Regulatory Agencies. Installation, materials, equipment, and workmanship shall conform to the applicable provisions of:
 - 1. National Electrical Code (NEC).
 - 2. National Electrical Safety Code (NESC).
 - 3. Terms and conditions of electrical utility and other authorities having lawful jurisdiction pertaining to work required.

1.4 MODIFICATIONS

- A. Contractor makes all modifications required by these applicable codes, rules, regulations, and authorities without additional charge to Owner.
- B. UL: All materials, appliances, equipment, or devices shall conform to applicable standards of UL. Label of, or listing by, UL is required.
- C. Standards: Where referenced in these Specifications or Drawings, publications and standards of the following organizations apply:
 - 1. ASTM, International.
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. Insulated Power Cable Engineers Association (IPCEA).
 - 4. National Electrical Manufacturers Association (NEMA).
 - 5. National Fire Protection Association (NFPA).
 - 6. American National Standards Institute (ANSI).
 - 7. Illuminating Engineering Society of North America (IESNA).

- D. Should Contractor observe any conflict or variation in Plans and Specifications, notify Engineer in writing no later than 10 days before date of Bid opening. Failure to clarify such variations will result in Electrical Contractor bearing all costs arising from electrical work done contrary to Specifications or Drawings.
- E. Electrical Contractor shall coordinate all conduit runs, control wiring, and electrical connections to equipment items furnished by Mechanical Contractor, General Contractor, Instrumentation Contractor, Owner, and other contractors under other Specification Sections.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 "Submittal Procedures."
- B. Shop Drawings: Submit Shop Drawings for approval. Show complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of a special nature or critical to installation and pertinent data required for installation. All descriptive and technical data and Shop Drawings shall bear signed certification that they were carefully examined and found correct with respect to dimension, space available, non-interference with other trades and that equipment complies with all Specification requirements. Where catalog data submitted, the clearly "flag" or otherwise identify proposed items so no confusion exists. In addition to specific references or requests, submit Shop Drawings for motor starters, switches, control devices, control systems, and sensing equipment.
- C. Substitutions: Submit proposed substitutions of electrical equipment, control devices, and other equipment with other submittal data. Accompany this request by complete descriptions of substitutes offered, including catalog cuts. Entire burden of proof of equality is placed on Contractor and Engineer decision is final.
- D. Test Data: Provide one copy of all data obtained during tests required in Specifications. Organize data in an orderly fashion, type, and indicate each test result. Submit for Engineer review within three days of performing required tests.

PART 2 - PRODUCTS

2.1 REQUIREMENTS

- A. Electrical requirements for equipment specified or indicated on Drawings are based on information available at time of design. If equipment furnished for installation has electrical requirements other than indicated on Electrical Drawings, Contractor shall make any required changes to wire and conduit size, controls, overcurrent protection, and installation as required to accommodate equipment supplied, without additional charge to Owner. Complete responsibility and costs for such adjustments shall be assigned to respective Specification Section where equipment is furnished.

2.2 MATERIALS

- A. All similar materials and equipment shall be the product of the same manufacturer unless specified otherwise. Where no specific material, apparatus, or appliance is mentioned, a first-class product, with Engineer approval, may be used. Materials and equipment shall be standard products of manufacturers regularly engaged in production of such material and manufacturer's current and standard design. Equipment affected by altitude shall perform satisfactorily for function intended at altitude of Project site.

PART 3 - EXECUTION

3.1 FABRICATION, ERECTION, AND INSTALLATION

- A. Fabrication, erection, and installation of complete electrical system shall be per accepted good practice by qualified personnel experienced in such work and proceed in an orderly manner, not impeding Project progress. Electrical Contractor shall check all areas and surfaces where electrical equipment material is installed, removed, or relocated then report any unsatisfactory conditions before starting work. Commencing work signifies Contractor acceptance of existing conditions. In acceptance or rejection of finished installation, no allowance made for lack of skill on the part of workmen.

3.2 TEMPORARY POWER AND LIGHTING

- A. Furnish and install temporary electrical facilities, if required, for construction and safety operations. No part of permanent electrical systems or existing electrical system may be used for temporary service unless approved by Engineer. Provide separate electrical metering for temporary power.

3.3 PERFORMANCE TESTS

- A. Thoroughly test all control circuits, fixtures, services and all circuits for proper operating condition and freedom from grounds and short circuits before requesting acceptance. Operate all equipment, appliances, and devices under load conditions. After interior wiring system installation is complete and when Engineer directs, conduct operating tests for approval. When requested, test all wire, cable, devices, and equipment after installation to assure all material possesses all original characteristics required by governing codes and standards listed herein.
- B. Perform such tests as required by other Specifications Sections or requested to prove acceptability. Furnish all instruments and labor for testing.

3.4 RECORD DRAWINGS

- A. During Work progress, maintain a clean, full set of project plans to record accurate, red-lined changes to system installation. Upon installation completion, submit full set of red-lined Drawings with all record data to Engineer.

3.5 OPERATING INSTRUCTIONS AND MANUALS

- A. Without additional charge to Owner, furnish complete instruction to Owner in care, adjustment, and operation of all electrical equipment and system parts. Upon Work completion, prepare and deliver to Owner four sets of complete operating and maintenance manuals for systems and major equipment installed. Include catalog data, Shop Drawings, wiring diagrams, performance curves and rating data, spare parts lists, and manufacturer operating maintenance data. Include a copy of test data collected during field tests in manuals.
- B. Requirements are in addition to specific instructions and manuals specified for individual systems or equipment.

3.6 DRAWINGS

- A. Electrical Drawings show general arrangement of all conduit, equipment, etc. and shall be followed as closely as actual building construction and work of other trades will permit. Structural Drawings shall be considered as a part of work insofar as these Drawings furnish Contractor with information relating to design and construction of building. Because of the small scale of Electrical Drawings, it is impossible to indicate all offsets, fittings, and accessories required. Contractor shall investigate structural and finish conditions affecting work and arrange work accordingly, providing such fittings, elbows, pull boxes, and accessories be required to meet such conditions.
- B. Field Measurements: Contractor shall verify dimensions governing electrical work at facility. No extra compensation claimed or allowed on account of differences between actual dimensions and those indicated on Drawings.
- C. Coordination Drawings: Where several trades' work must be sequenced and positioned with precision to fit into available space, prepare Coordination Drawings (Shop Drawings) showing actual physical dimensions (at accurate scale) required for installation if Engineer deems necessary. Prepare and submit these Coordination Drawings, if required, before purchase-fabrication-installation of any of these elements involved in coordination.

3.7 LOCATION OF EQUIPMENT AND OUTLETS

- A. Approximate locations of cabinets, conduits, controllers, power outlets, etc., are indicated on Drawings; however, not intended to give complete and detailed information. Determine exact location after thoroughly examining general building plans and actual measurements during construction, subject to the approval of Engineer.

3.8 EXISTING ELECTRICAL

- A. Existing electrical system information has been obtained from most up-to-date source and documents, but accuracy not guaranteed. Contractor shall familiarize himself with existing conditions before preparing bid.
- B. Only existing electrical affected by this Contract is shown on Drawings. Existing electrical not shown in Drawings is to remain in place and in operation. Repair or replace all existing electrical damaged during construction .
- C. Contractor responsible for damage to existing walls/ceilings due to electrical construction. Repairing damage to existing building shall be by proper trades involved.

3.9 PAYMENT

- A. Payment made for all Work covered herein at Contract unit price per unit or included in lump sum price per job for items, as shown on proposal. Either such payment shall be complete compensation for complete performance of Work per Drawings and Specification provisions.

END OF SECTION

SECTION 26 05 13 - BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building wire and cable.
 - 2. Wiring connectors and connections.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 05 53 "Electrical Identification."

1.2 REFERENCES

- A. Refer to Section 01 40 00 "Quality Requirements" for reference and standard requirements.
- B. NECA Standard of Installation (National Electrical Contractors Association).
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- D. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

- A. Refer to Section 01 33 00 "Submittal Procedures" for procedures for submittals.
- B. Product Data: Provide for each cable assembly type.

1.4 SUBMITTALS FOR INFORMATION

- A. Refer to Section 01 33 00 "Submittal Procedures" for procedures for submittals.
- B. Test Reports: Indicate procedures and values obtained.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Refer to Section 01 70 00 "Execution and Closeout Requirements" for closeout submittals procedures.
- B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified herein with minimum 3 years' documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.8 FIELD SAMPLES

- A. Provide under provisions of Section 01 40 00 "Quality Requirements."

1.9 PROJECT CONDITIONS

- A. Refer to Section 01 30 00 "Administrative Requirements."
- B. Verify field measurements are as indicated.
- C. Conductor sizes are based on copper.
- D. Wire and cable routing indicated is approximate unless dimensioned.

1.10 COORDINATION

- A. Coordinate Work under provisions of Section 01 30 00 "Administrative Requirements."
- B. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. American Cable.
 - 2. Houston Wire and Cable.
 - 3. Southwire.
 - 4. Substitutions: Refer to Section 01 60 00 "Product Requirements."
- B. Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation: NFPA 70, Type THW, THHN/THWN, and XHHW.

2.2 POWER WIRE AND CABLE

- A. Description: Tray Cable Rated, multi-conductor, insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70; Type THHN/THWN-2, 90 degrees C insulation for service entrance, feeders, and branch circuits.

2.3 VFD CABLE

- A. Description: Shielded motor supply cable for variable frequency drives. Materials used are designed to hold up to the non-linear power distortions associated with VFD drives.
- B. Construction: Finely stranded tinned copper conductors; composite insulation; barrier tape; 100 percent shielding with foil tape and tinned copper braid, PVC black jacket, TC-rated.
- C. Nominal Voltage: 600V-UL, 1000V-UL AWM.
- D. Color Code: Three black conductors with white numbers, plus green ground.
- E. Temperature Rating: Minus 25 to plus 90 degrees C.
- F. Cable termination kits shall be supplied from cable manufacturer.

2.4 CONTROL CABLE

- A. Analog I/O wiring shall be 16 AWG, twisted pair shielded, Belden 8719 or equal.
- B. Discrete I/O wiring shall be 16AWG, 600V, stranded copper, THWN. Use multi-conductor cable when possible.

2.5 WIRING CONNECTORS

- A. Split Bolt Connectors:
 - 1. IlSCO.
 - 2. Buchanan.
 - 3. Burndy.
 - 4. Substitutions: Refer to Section 01 60 00 "Product Requirements."
- B. Solderless Pressure Connectors:
 - 1. IlSCO.
 - 2. Buchanan.
 - 3. Burndy.
 - 4. Substitutions: Refer to Section 01 60 00 "Product Requirements."
- C. Spring Wire Connectors:
 - 1. Ideal.
 - 2. Substitutions: Refer to Section 01 60 00 "Product Requirements."
- D. Compression Connectors:
 - 1. IlSCO.
 - 2. Buchanan.
 - 3. Burndy.
 - 4. Substitutions: Refer to Section 01 60 00 "Product Requirements."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Refer to Section 01 30 00 "Administrative Requirements" to verify existing conditions before starting Work.
- B. Verify interior of building is protected from weather.
- C. Verify mechanical work likely to damage wire and cable is complete.
- D. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. All Locations: Use only building wire, Type THW or THHN/THWN insulation in raceway.

3.4 INSTALLATION

- A. Refer to Section 01 40 00 "Quality Requirements" for manufacturer instructions.
- B. Route wire and cable as required to meet Project Conditions.
- C. Install cable per NECA "Standard of Installation."

- D. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- E. Use stranded conductors for control circuits.
- F. Use conductor not smaller than 12 AWG for power and lighting circuits.
- G. Use conductor not smaller than 14 AWG for control circuits.
- H. Use 10 AWG conductors for 20 amperes, 120-volt branch circuits longer than 75 feet.
- I. Install all conductors in conduit unless otherwise noted.
- J. Pull all conductors into raceway at same time.
- K. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- L. Protect exposed cable from damage.
- M. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- N. Use suitable cable fittings and connectors.
- O. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- P. Clean conductor surfaces before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- R. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- S. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- T. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- U. Identify and color code wire and cable under provisions of Section 26 05 53 "Electrical Identification." Identify each conductor with circuit number or other designation indicated.
- V. Number of conductors in each conduit run shall be limited to requirements indicated on Drawings and stated in Article 310 of the 2002 National Electrical Code.
- W. Install all conductors in conduit unless specifically noted otherwise in other Specifications.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify each conductor with its destination terminal block.

3.6 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 "Quality Requirements" for field inspection, testing, and adjusting.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NcETA ATS, Section 7.3.1.
- D. Measure tightness of bolted connections.
- E. Verify continuity of each branch circuit conductor.

3.7 PAYMENT

- A. Payment will be made for all Work covered under this Section at the Contract unit price per unit or will be included in the lump sum price per job for items, as shown on the Proposal. Either such payment shall be complete compensation for the complete performance of Work per Drawings and provisions of the Specifications.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grounding electrodes and conductors.
 - 2. Equipment grounding conductors.
 - 3. Bonding.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

- A. Refer to Section 01 40 00 "Quality Requirements" for reference and standard requirements.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- C. NFPA 70 - National Electrical Code.

1.3 GROUNDING SYSTEM DESCRIPTION

- A. Metal underground water pipe.
- B. Metal frame of the building.
- C. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

- A. Maximum Grounding System Resistance: 10 ohms.

1.5 SUBMITTALS FOR REVIEW

- A. Refer to Section 01 33 00 "Submittal Procedures" for submittal procedures.
- B. Product Data: Provide for grounding electrodes and connections.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Refer to Section 01 70 00 "Execution and Closeout Requirements" for submittal procedures.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified herein with minimum 3 years' documented experience with service facilities within 100 miles of Project.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by UL, Inc. as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Material: Copper.
- B. Diameter: 3/4-inch.
- C. Length: 10 feet.

2.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

- A. Exothermic connectors, rod electrodes and other grounding related equipment supplied by manufacturers with 10 years of experience in manufacturing.

2.4 WIRE

- A. Material: Stranded copper.
- B. Foundation electrodes: 2 AWG x 20 feet long.
- C. Grounding Electrode Conductor: Minimum size to meet NFPA 70 requirements or as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Refer to Section 01 30 00 "Administrative Requirements" for verification of existing conditions prior to beginning Work.
- B. Verify final backfill and compaction was completed before driving rod electrodes.

3.2 INSTALLATION

- A. Refer to Section 01 40 00 "Quality Requirements" for manufacturer instructions.
- B. Install rod electrodes as required to achieve a minimum resistance to ground of 10 ohms.
- C. Provide bonding to meet Regulatory Requirements.
- D. Bond together metal siding not attached to grounded structure; bond to ground.
- E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- F. Provide bonding of reinforcing steel in concrete foundation, building steel, steel water pipes, and any supplemental electrodes (rods) per National Electrical Code and Drawings.

3.3 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 “Quality Requirements” for field inspection, testing, and adjusting.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION

SECTION 26 05 29 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit and equipment supports.
 - 2. Anchors and fasteners.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Use expansion anchors, powder-actuated anchors, and preset inserts.
 - 2. Steel Structural Elements: Use beam clamps, spring steel clips and steel ramset fasteners.
 - 3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
 - 4. Sheet Metal: Use sheet metal screws.
 - 5. Wood Elements: Use wood screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation."
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Obtain permission from Engineer before drilling or cutting structural members.
- E. Fabricate supports from structural steel as indicated on Drawings. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use lock washers under all nuts.

- F. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- G. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 1 inch off wall.
- H. Install conduit supports a maximum spacing specified in the NEC.

END OF SECTION

SECTION 26 05 33 - CONDUIT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal conduit.
 - 2. Flexible metal conduit.
 - 3. Liquidtight flexible metal conduit.
 - 4. Electrical metallic tubing.
 - 5. Conduit fittings.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 05 26 "Grounding and Bonding."
 - 3. Section 26 05 29 "Supporting Devices."
 - 4. Section 26 05 33.16 "Boxes."
 - 5. Section 26 05 53 "Electrical Identification."

1.2 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NECA "Standard of Installation."
- F. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 "Submittal Procedures."
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, nonmetallic conduit, fittings, and conduit bodies.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 70 00 "Execution and Closeout Requirements."
- B. Accurately record actual routing of conduits.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00 “Product Requirements.”
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS

- A. Verify field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on the Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Conduit Minimum Size: 3/4-inch unless otherwise specified.
- B. Rigid Metallic Conduit (RMC): Hot-Dipped Galvanized Rigid Steel, ANSI C80.1. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.
- C. Liquidtight Flexible Metal Conduit: Interlocked steel construction with PVC jacket. Flexible conduit shall be used only for connection to devices and structures subject to vibration. Maximum length of flexible conduit shall be 3 feet.
- D. PVC-Coated RMC: 40 mil gray PVC exterior coating over galvanized rigid conduit, clear urethane coating over hot-galvanized threads, UL listed with PVC as primary corrosion protection for steel conduit with an underlying zinc coating as supplemental corrosion protection coating. Fittings and conduit bodies shall be by the same manufacturer as conduit. UL-listed Standard 514B, material and coatings to match conduit
- E. Rigid Nonmetallic Conduit (RNC): NEMA TC 2; Schedule 40 PVC. PVC Fittings and Conduit Bodies: NEMA TC

2.2 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied
 - 2. Wheatland
 - 3. Substitutions: Under provisions of Section 01 60 00 “Product Requirements.”
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; all steel fittings.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Ultatite.
 - 2. Electri-flex.
 - 3. Substitutions: Under provisions of Section 01 60 00 “Product Requirements.”

- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB 1.
- D. Applications: Use for final connections to motorized equipment in exterior locations.

2.4 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. Levy.
 - 2. Robroy Industries.
 - 3. Substitutions: Under provisions of Section 01 60 00 "Product Requirements."
- B. Description: NEMA RN-1, rigid steel conduit with external PVC coating, 20 mil thick.
- C. Protective layer may be factory applied or galvanized rigid steel conduit applied with two layers of corrosion resistant tape.
- D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coatings to match conduit.

2.5 NONMETALLIC CONDUIT

- A. Manufacturer: Carlon.
- B. NEMA TC2, Schedule 40, sunlight resistant and rated for direct-buried applications.
- C. Limited to below grade use.

2.6 CONDUIT FITTINGS

- A. Couplings and Terminations for Rigid Steel Conduit: Factory made steel threaded couplings conforming to ANSI/NEMA FB1; bushing at all boxes and cabinets, with locknuts inside and outside box or cabinet.
- B. Couplings and Terminations for Flexible Metal Conduit: Conforming to ANSI/NEMA FB1 T&B 440 Series or approved equivalent couplings at connection between flexible and rigid conduit; T&B 3110 or 3130 Series or approved equivalent nylon insulated throat, steel connectors at box or cabinet terminations.
- C. Couplings and Terminations for PVC Conduit: Type 40 heavy wall, high-impact rigid virgin polyvinyl chloride (PVC) fittings, conforming to NEMA Publications TC2 and TC3 and UL listed for direct burial use; Carlon or approved equivalent. PVC couplings and solvent cement by the same manufacturer as PVC conduit.

PART 3 - EXECUTION

3.1 UNDERGROUND INSTALLATIONS

- A. At 18 inches below grade and lower utilize RNC. If underground conduit run is not encased in concrete, place 4 inches of sand below and above conduit and install a red traceable ribbon 6 inches above top of conduit for entire length of underground run.
- B. Any conduit located less than 18 inches below grade shall be PVC-coated RMC or RNC encased in concrete.
- C. When transferring from below grade to above grade, use PVC-coated RMC Ells.

3.2 ABOVEGROUND INSTALLATIONS

- A. Wet and Damp Locations: Use RMC.
- B. Dry Locations: Use electrical metallic tubing, zinc coated, where conduit is concealed. Use RMC where conduit is exposed.

3.3 OUTDOOR VAULTS

- A. All conduits and fittings located in outdoor vaults, including conduits encased in walls and floors of vaults, shall be PVC-coated RMC.

3.4 INSTALLATION

- A. Install conduit per NECA "Standard of Installation." Install nonmetallic conduit and PVC-coated RMC per manufacturer instructions. Arrange supports to prevent misalignment during wiring installation. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and splint hangers. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25-percent additional conduits. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29 "Supporting Devices." Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- B. Arrange conduit to maintain headroom and present neat appearance. Route exposed conduit parallel and perpendicular to walls. Maintain adequate clearance between conduit and piping. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F. Remove all sharp edges from ends after cutting. Do not use pipe cutters for cutting conduit. Bring conduit to shoulder of fittings; fasten securely.
- C. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- D. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bends shall be made so as not to alter the cross-sectional area of the conduit.
- E. On PVC-coated RMC, use touchup compound on all field cut threads and internal reams. Touchup compound shall be as recommended by PVC-coated RMC manufacturer.
- F. Clamp, cut, thread, bend, and assemble PVC-coated RMC per manufacturer-recommended installation guide. If manufacturer does not provide a detailed installation guide, follow the Perma-Cote Installation Guide, 2005 Order Item 10 PC-2002.
- G. Use suitable caps to protect installed conduit against entrance of dirt and moisture. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control, and expansion joints. Provide suitable pull string in each empty conduit except sleeves and nipples.
- H. Tag all conduits identified on a conduit schedule at each end and where wall or floor penetrations made, with metal tags engraved or stamped to identify conduit per identification on schedule.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Route conduit through roof openings for piping and ductwork or through suitable roof jack as detailed in Architectural Drawings. Coordinate location with roofing installation.

END OF SECTION

SECTION 26 05 33.16 – BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall and ceiling outlet boxes.
 - 2. Pull and junction boxes.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 27 26 “Wiring Devices” for wall plates in finished areas.

1.2 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
- E. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR CLOSEOUT

- A. Refer to Section 01 70 00 “Execution and Closeout Requirement” for Project closeout submittals.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on Project Record documents.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by UL, as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Cast Boxes: NEMA FB 1, Type FD, cast alloy. Provide gasketed cover by box manufacturer.
- B. Wall Plates for Finished Areas: As specified in Section 26 27 26 “Wiring Devices.”

2.2 PULL AND JUNCTION BOXES

- A. Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface-mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with flange, neoprene gasket, and stainless-steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of outlets in all location areas prior to rough-in.

3.2 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- C. Set wall-mounted boxes at elevations to accommodate mounting heights specified in Section for outlet device.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose.
- E. Orient boxes to accommodate wiring devices as specified in Section 26 27 26 "Wiring Devices."
- F. Maintain headroom and present neat mechanical appearance.
- G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- I. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- J. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- K. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices. All such devices shall be mounted at same elevation.
- L. Use flush-mounting outlet box in finished areas.
- M. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- N. Do not install flush mounting box back-to-back in walls; provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic-rated walls.
- O. Secure flush-mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- P. Use stamped steel bridges to fasten flush-mounting outlet box between studs. In lieu of bridges, provide boxes with brackets that limit box travel by contacting adjacent wall.
- Q. Install flush-mounting box without damaging wall insulation or reducing effectiveness.
- R. Use adjustable steel channel fasteners for hung ceiling outlet box.
- S. Do not fasten boxes to ceiling support wires.
- T. Support boxes independently of conduit.
- U. Use gang box where more than one device mounted together. Do not use sectional box.
- V. Use gang box with plaster ring for single device outlets.
- W. Use cast outlet box in exterior locations exposed to weather and wet locations. Do not use non-metallic boxes.
- X. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate Installation of box for intended use or equipment to be connected.

3.4 ADJUSTING

- A. Refer to Section 01 70 00 "Execution and Closeout Requirements" for adjusting installed Work.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

3.5 CLEANING

- A. Refer to Section 01 70 00 "Execution and Closeout Requirements" for cleaning installed work.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates and labels.
 - 2. Wire and cable markers.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. Engraved three-layer laminated plastic, white letters on black background.
- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Field disconnects, start stop stations, control panels.
- C. Letter Size:
 - 1. 1/4-inch for identifying individual equipment and loads.
 - 2. 1/4-inch for identifying grouped equipment and loads.
 - 3. 3/8-inch for identifying Main Disconnect equipment.

2.2 BOX MARKERS

- A. Label each fire alarm system junction box cover with red paint on box cover.
- B. All junction boxes in accessible location shall have box cover labeled to indicate which circuit and panel they are served from.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using screws or rivets.
- C. Identify underground conduits using underground warning tape. Install one tape per trench 3 inches below finished grade. Identify all conduit at exposed locations into all boxes, cabinets, etc.

- D. Identify all conductors at every termination indicating endpoints of termination and tag identification as required.
- E. Color coding for phase identification:

120/208 volts	Phase	277/480 volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- F. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by colored electrical tape. Conductor identification provided within each enclosure where a tap, splice, or termination is made.

END OF SECTION

SECTION 26 08 00 - COMMISSIONING ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes testing procedures and methods required prior to acceptance of electrical systems by Owner. Electrical system start-up procedures.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 05 00 "Basic Electrical Methods."
 - 3. Section 26 05 13 "Building Wire and Cable."
 - 4. Section 26 05 26 "Grounding and Bonding."

1.2 REFERENCES

- A. National Electrical Code - NEC.
- B. National Electrical Manufacturer's Association - NEMA.
- C. ASTM, International.
- D. Institute of Electrical and Electronic Engineers - IEEE.
- E. American National Standards Institute - ANSI.
- F. ANSI C2 - National Electrical Safety Code.
- G. ANSI Z244-1 - American National Standard for Protection.
- H. Manufacturer's instruction manuals applicable to each particular apparatus.
- I. ICEA - Insulated Cable Engineers Association.

1.3 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 33 00 "Submittal Procedures." Document calibration of all equipment utilized in electrical system tests and verify. Accuracy of test instruments shall be directly traceable to National Bureau of Standards. Calibrate:
 - 1. Analog field instruments within 6 months of use.
 - 2. Digital field instruments within 12 months of use.
 - 3. Leased instruments within 12 months of use where accuracy is guaranteed by lessor.
- B. Accurately record field data obtained during tests as acceptable to Owner. Provide 3 copies of tests summary to Owner in a form acceptable to Owner.

PART 2 - PRODUCTS

2.1 CABLE TESTS

- A. Power Cable 600V and Below:
 - 1. All power cables shall meet/exceed applicable ICEA test requirements for type of insulation used and application. Manufacturer provides verification in the form of published literature or submittal.
 - 2. After installation and before rated voltage is applied to any power cable #8 AWG or larger, make a DC insulation check for each cable with a megohmmeter. Applied potential shall be 1,000-volts DC for one minute. Properly corona suppress terminations by guard ring, field reduction sphere, or other suitable method. For any reading less than 100 megohms, correct the cause of low reading or replace cable.

2.2 GROUNDING SYSTEMS

- A. Inspect ground system for compliance with plans and specifications. Perform three-point fall-of-potential test per IEEE Standard No. 81, Section 9.04 on main grounding electrode. Resistance to ground shall be no greater than 1 ohm. Contractor responsible for installing additional electrodes as required to lower resistance to 1 ohm, if greater, at no additional expense to Owner.

2.3 FIELD DEVICE TESTS

- A. Visually inspect all electrical equipment for physical damage and proper installation. Calibrate devices per manufacturer recommendations. Verify proper operation of all field devices before startup.

2.4 ELECTRICAL READINGS AND SETTINGS

- A. After motor operation is verified, take voltage readings at all panelboards and starters. Based on readings, make final adjustments of primary taps on all transformers in building as needed or coordinate with electric utility for proper building voltage.
- B. With all motors fully loaded and running at 100-percent speed, fully loaded and running at 85 percent speed, with motor drives off, record the following readings on each phase of load side of service entrance main breaker and submit to Engineer:
 - 1. Voltage (phase-to-phase and phase-to-neutral).
 - 2. Amperage.
 - 3. Power Factor.
 - 4. Frequency.
 - 5. Total harmonic current distortion.
 - 6. Total harmonic voltage distortion.

PART 3 - EXECUTION

3.1 GENERAL

- A. Startup procedures assure that equipment and systems utilized are ready for operation and use. Contractor will perform startup with Engineer and Owner representative (if desired) present.

3.2 PROCEDURE

- A. Operate field devices and other equipment utilized as required for efficient system operation. Contractor shall demonstrate that field devices work as specified. Upon effectively demonstrating satisfactory operation of all electrical systems, Contractor will energize all equipment not adversely affected for seven days. Replace any controls or other equipment found defective before acceptance by Owner. Contractor shall provide "Certification of Proper Operation" to Engineer upon completion of Start-Up.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. 120/240 and 480/277 VAC distribution panelboards.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 05 29 "Supporting Devices."

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA PB 1 - Panelboards.
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards. Rated 600 Volts or Less.
- E. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of General Conditions:
 - 1. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.
 - 2. Manufacturer Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
 - 3. Project Record Documents: Record actual locations of products and indicate actual branch circuit arrangement.
 - 4. Operation and Maintenance Data: Include spare parts data listing and recommended maintenance procedures and intervals.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified herein with minimum 5 years' experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.7 GENERAL CONDITIONS

- A. Provide two of each panelboard key if required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Independently-mounted panelboards shall be manufactured by:
 - 1. Square D;
 - 2. Cutler Hammer; or
 - 3. Equivalent.

2.2 480/277 VAC DISTRIBUTION PANEL BOARDS

- A. Panelboards:
 - 1. 480/277 VAC.
 - 2. Three phase.
 - 3. Four wire, 60 Hertz.
- B. Service Conditions:
 - 1. Temperature: 105 degrees F.
 - 2. Altitude: 3,000 feet.
 - 3. Bus: Copper.
- C. Provide copper ground bus and copper neutral bus in each panelboard.
 - a. Minimum integrated short-circuit rating: 35k amperes RMS symmetrical at 480 VAC or as indicated on drawings.
 - b. Molded-Case Circuit Breakers: NEMA AB 1, bolt-on type.
 - c. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
 - d. Provide circuit breaker accessory trip units and auxiliary switches.
 - e. Doors: Secured with vault-type latch with tumbler lock; keyed alike. For doors over 36 inches high provide two latches; keyed alike.

2.3 120/240 VAC DISTRIBUTION PANEL BOARDS

- A. Panelboards:
 - 1. 240/120 VAC.
 - 2. One phase.
 - 3. Four wire, 60 Hertz.

- B. Service Conditions:
 - 1. Temperature: 105 degrees F.
 - 2. Altitude: 3,000 feet.
 - 3. Bus: Copper.
- C. Provide copper ground bus in each panelboard.
 - 1. Minimum integrated short-circuit rating: 35k amperes RMS symmetrical at 240 VAC.
 - 2. Molded-Case Circuit Breakers: NEMA AB trip in each pole.
 - 3. Provide circuit breaker accessory trip units and auxiliary switches as indicated.
 - 4. Doors: Secured with vault-type latch with tumbler lock; keyed alike. For doors over 36 inches high provide two latches; keyed alike.

2.4 120/240 PANELBOARD WITH TRANSFORMER

- A. Mini Power Zone: Square D Mini Power Zone Dry-Type Package Power Supply or approved equal. Minimum integrated short circuit rating of 18,000 amperes RMS symmetrical at 240 VAC. Transformer rating as indicated on Drawings with 480 volt primary and 240/120 volt secondary. Transformers are to be encapsulated to provide protection against moisture, dust, and corrosive environments. Panelboard shall be supplied with bolt-on-type breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards per NEMA PB 1.1. Install panelboards plumb. Provide supports per Drawings and Section 26 05 29 "Supporting Devices." Height is 6-foot maximum to top of panelboard. Provide filler plates for unused spaces in panelboards. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. Label spare slots as such in erasable pencil on directory. Provide black-on-white engraved plastic nameplates.

3.2 FIELD QUALITY CONTROL

- A. Perform a field inspection and test for grounds on each circuit after installation is complete. Measure steady state load currents at each panelboard feeder, rearranging panelboard circuits to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.3 PAYMENT

- A. Payment made for all Work covered herein at Contract unit price per unit or included in lump sum price per job for items, as shown on Proposal. Either such payment shall be complete compensation for complete performance of Work per Drawings and Specification provisions.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall switches, receptacles, and device plates.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 05 33.16 "Boxes."

1.2 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device - Dimensional Requirements.
- D. NFPA 70 - National Electric Code.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified herein with minimum 3 years' documented experience.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed/classified by UL, as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:
 - 1. General Electric: Model 5951-2G;
 - 2. Hubbell: Model 1221-I;
 - 3. P&S: Model 20-AC-1-1; or
 - 4. Approved equal.
- B. Description: NEMA WD 1, Specification Grade, AC only general-use snap switch.
- C. Body and Handle: Ivory plastic with toggle handle.
- D. Ratings:
 - 1. Voltage 120/277 volts, AC.
 - 2. Current: 20 amperes.

2.2 RECEPTACLES

- A. Manufacturers:
 - 1. General Electric: Model 5362-2;
 - 2. Hubbel: Model 5362-1; or
 - 3. Approved equal.

- B. Description: NEMA WD 1, Specification Grade general-use receptacle.
- C. Device Body: Ivory plastic.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: 20 amp rated convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- G. Outdoor receptacles shall have a weatherproof enclosure whether or not attachment plug cap is inserted.

2.3 WALL PLATES

- A. Provide plates for each switch and receptacle device. Provide stainless steel wall plates.
- B. Exposed: Plates for exposed screw jointed fittings shall match fittings with edges of plates flush with edges of fittings. Plates for cast-type boxes shall be cast, vapor-tight type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of existing conditions prior to beginning Work.
- B. Verify outlet boxes are installed at proper height.
- C. Verify required wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready to connect to wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on bottom.
- E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- F. Connect wiring devices by wrapping conductor around screw terminal.
- G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 "Boxes" to obtain mounting heights specified and indicated on drawings.
- B. Install wall switch 44 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Refer to Section 01 70 00 "Execution and Closeout Requirements."
- B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Refer to Section 01 70 00 "Execution and Closeout Requirements."
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 29 23 - VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Variable frequency ac drive (VFD).
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 REFERENCES

- A. IEEE C62.41 (Institute of Electrical and Electronics Engineers) - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE Standard 519-1992, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- C. NEMA FU 1 (National Electrical Manufacturers Association) - Fuses.
- D. NEMA ICS 2 – Industrial Control Devices, Controllers and Assemblies.
- E. NEMA ICS 3.1 (National Electrical Manufacturers Association) - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- F. NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
- G. NEMA ICS 7 (National Electrical Manufacturers Association) - Industrial Control and Systems: Adjustable Speed Drives.
- H. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 “Submittal Procedures.”
- B. Include a copy of this Specification Section with each paragraph checked with which the proposed unit fully complies. Paragraphs having requirements which are not met or where alternatives are proposed shall be numbered on the right-hand side. A corresponding numbered paragraph shall be attached to the Specification indicating equipment differences or proposed modifications. Submittal not having the above documentation will be rejected.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- D. Product Data: Submit catalog sheets showing voltage, controller size, ratings, and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- E. Total Harmonic Distortion Calculation: These calculations shall be calculated under worst case conditions in accordance with the procedure outlined in IEEE standard 519-1992 and submitted with Shop Drawings and Product Data.
- F. Test Reports: Indicate field test and inspection procedures and test results.
- G. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 3.1. Include procedures for starting and operating controllers and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 QUALITY ASSURANCE

- A. All products shall be UL labeled and meet the requirements of UL-508C
- B. Total harmonic distortion shall be calculated under worst case conditions in accordance with procedure outlined in IEEE Standard 519-1992.
- C. The VFD shall be tested by the manufacturer before shipping. The VFD shall operate a dynamometer at full load and speed under elevated temperature conditions.
- D. All optional features shall be functionally tested at the factory for proper operation.
- E. Factory test documentation shall be available upon request.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years of documented experience, and with representative capable of on-site assistance available on site within 24 hours of drive failure.
- B. The manufacturer shall be both ISO-9001 and ISO14001 certified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.9 WARRANTY

- A. Submit under provisions of Division 01.
- B. Furnish manufacturer extended warranty for variable frequency controllers for a period of 2 years after substantial completion certificate has been issued. This warranty as a minimum shall include parts and labor for any repairs within the warranty period.

1.10 MAINTENANCE SERVICE

- A. The VFD manufacturer shall provide a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified technicians for VFD field repair shall not be acceptable as start-up agents.

1.11 MAINTENANCE MATERIALS

- A. Manufacturer shall provide a recommended spare parts list.
- B. Furnish two of each air filter.

PART 2 - PRODUCT

2.1 GENERAL

- A. Furnish a complete VFD as specified herein for loads designated to be variable speed. The VFD and all required options will be incorporated by the VFD manufacturer into an integrated package, with a single input feed and main circuit breaker disconnect. Approved drive manufacturers and model series are as follows; no substitutions will be accepted.
 - 1. MCI Motor Controls, Inc.
 - 2. Danfoss VLT AQUA drive.
 - 3. Allen Bradley Powerflex.
 - 4. Approved equal.
- B. VFD capabilities listed in this Specification are minimum requirements that are not necessarily all inclusive for manufacturers and/or models listed.
- C. VFD dimensions indicated on Drawings are based on information available at the time of design. Contractor shall verify that the VFDs submitted for this Project will comply with NEC working space requirements, as well as its own spacing requirements for adequate air flow. If VFDs furnished for installation have dimensions other than indicated on Drawings, the Contractor shall make any required changes to wire and conduit to accommodate the equipment supplied without additional charge to the Owner.
- D. Maximum Dimensions of VFDs shall be as shown on the Drawings.
- E. VFD shall be bottom entry and bottom exit.

2.2 DISCONNECT

- A. Combine VFD with MCP breaker disconnect or a fused disconnect in common enclosure. Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified person. Include means to lock the disconnect in the OFF position.
- B. Motor Circuit Protector (MCP): NEMA AB1, circuit breaker with integral instantaneous magnetic trip in each pole, maximum setting of 800 percent of full-load current.

2.3 CAPABILITIES

- A. VFD's shall be variable torque rated.
- B. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up 200 feet (unshielded) without tripping.

- C. The VFD shall be capable of producing rated RMS fundamental output voltage without increasing the input voltage above motor nameplate value.
- D. The VFD must be able to source the motor's full load nameplate amperage on a continuous basis and be capable of running the motor at its nameplate RPM, voltage, current, and slip without having to utilize the service factor of the motor.
- E. The VFD shall be able to provide full torque at any speed up to the base speed of the motor.
- F. The VFD shall be able to provide its full rated output current continuously and 110 percent of rated current for 60 seconds.
- G. VFD shall provide full torque to the motor given input voltage fluctuations of up to ± 10 percent of the rated input voltage. Line voltage reductions up to 15 percent shall not cause the VFD to trip.
- H. The VFD shall have input surge protection to withstand surges of 2.3 times line voltage for 1.3 msec.
- I. VFD shall be capable of detecting phase imbalance and phase loss on the input side of the VFD.
- J. VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
- K. VFD enclosures shall be made of metal to minimize RFI.
- L. VFD shall display all faults in plain text; VFD's which can display only fault codes are not acceptable.
- M. The VFD shall have one 4-20mA analog input signal for remote speed setpoint.
- N. The VFD shall have two 4-20mA analog output signals for motor speed and motor current.
- O. When in AUTO mode, the VFD shall be capable of receiving discrete inputs from the PLC that initiate the following actions:
 - 1. Start
 - 2. Stop
 - 3. Fault Reset
- P. The drive shall provide 230VAC/2A rated dry contact relay outputs that indicate the following status:
 - 1. Drive in Manual
 - 2. Drive in Auto
 - 3. VFD Ready
 - 4. VFD Running
 - 5. VFD Fault
- Q. All motor and pump protection shall be independent of the RTU controller. Protection devices that are required by the pump or motor, and are not covered in this Section, shall be incorporated into the VFD control at no additional cost to the Owner.

2.4 DESIGN

- A. VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge. VFDs utilizing controlled SCR rectifiers shall not be acceptable.
- B. The VFD shall maintain a displacement power factor of near unity regardless of speed and load.

- C. The VFD shall provide dual built-in DC link reactors to minimize power line harmonics and to provide near unity power factor. VFD's without a DC link reactor shall provide a 5 percent impedance line side reactor, at a minimum.
- D. The VFD shall have the option of an integral RFI filter.
- E. Employ microprocessor-based inverter logic isolated from power circuits.
- F. Employ pulse-width-modulated output design utilizing current IGBT inverter technology

2.5 COMMUNICATIONS CAPABILITY

- A. The VFD shall have as standard a RJ-45 Ethernet port which allows Ethernet communication to the Human Machine Interface (HMI) computer.
- B. The VFD shall have the capability of communicating the following through the Ethernet Communications:
 - 1. Line Fault
 - 2. Ground Fault
 - 3. Phase Reversal
 - 4. Jam Fault
 - 5. Stall
 - 6. Overcurrent
 - 7. Over Voltage
 - 8. Under Voltage
 - 9. Voltage Unbalance
 - 10. Over Temperature
 - 11. Overload
 - 12. Excessive Starts Per Hour
 - 13. Three Phase Currents
 - 14. Three Phase Voltage
 - 15. Power in KW
 - 16. Power Usage in KWH
 - 17. Power Factor
 - 18. Elapsed Time
 - 19. Motor Speed
 - 20. Motor Start
 - 21. Motor Stop

2.6 RATINGS

- A. Rated Input Voltage: As indicated on Drawings.
- B. Motor: Horsepower as shown on One-line Drawings.
- C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
- D. Operating Ambient: 0 degrees C to 50 degrees C.
- E. Minimum Efficiency at Full Load: 95 percent.
- F. Time to Stop: 0 to 3,600 seconds (field adjustable)

2.7 PRODUCT OPTIONS AND FEATURES

- A. The VFD shall have a temperature-controlled cooling fan for quiet operation.

- B. Volts per Hertz Adjustment: Plus or minus 10 percent.
- C. Current Limit Adjustment: 60 to 110 percent of rated current.
- D. Acceleration Rate Adjustment: 0.5 to 600 seconds.
- E. Deceleration Rate Adjustment: .05 to 600 seconds.
- F. Include undervoltage release.
- G. Safety Interlocks: Furnish terminals for a remote “Stop/Lockout” switch located at the motor to inhibit starting under manual, and automatic modes.
- H. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
- I. Ground Fault Detection: Sense ground fault current and shuts down the drive.

2.8 FABRICATION

- A. VFDs are to be bottom entry and bottom exit.
- B. Wiring Terminations: Input and output power cable connections shall accommodate the conductor materials and sizes indicated on drawings.
- C. Enclosure: NEMA 250, Type 3R, suitable for equipment application in places restricted to persons employed on the premises and accessible only to qualified personnel. Front cover to be solid.
- D. Finish: Manufacturers standard enamel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify building environment is maintained within service conditions required by manufacturer.

3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- D. Install white lettering on black background engraved plastic nameplates. Nameplate to be 2 inches in height.
- E. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- F. Ground and bond controller in accordance with Section 26 05 26 “Grounding and Bonding.”
- G. Install VFDs plumb. Provide supports in accordance with Section 26 25 29.
- H. Height: 5 foot-6-inch maximum to all operating or monitoring devices.

3.3 STARTUP

- A. Start-Up and programming of the VFD and any other supplied components shall be done at project site by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified technicians for VFD field repair are not acceptable as start-up agents.
- B. The manufacturer shall provide free 24-hour. customer technical support.

3.4 FIELD QUALITY CONTROL

- A. Section 26 05 00 “Basic Electrical Methods.”
- B. Inspect and test in accordance with other specification sections and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 3.1.

3.5 DEMONSTRATION AND TRAINING

- A. Furnish 4 hours of instruction for 4 persons. Training to be conducted at Project site with authorized manufacturer's representative.

3.6 PAYMENT

- A. Payment will be made for all Work covered in this Section at the Contract unit price per unit or will be included in the lump sum price per job for items, as shown on the Proposal. Either such payment shall be complete compensation for the complete performance of Work in accordance with the Drawings and the provisions of these Specifications.

END OF SECTION

SECTION 26 43 00 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Surge Protective Device (SPD) (former Transient Voltage Surge Suppression devices, TVSS). SPD used herein and all Drawings.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 26 05 26 "Grounding and Bonding."
 - 3. Section 26 27 26 "Wiring Devices."

1.2 REFERENCES

- A. Specified system shall be designed, manufactured, tested, and installed in compliance with:
 - 1. Canadian Standards Association (CSA).
 - 2. American National Standards Institute.
 - 3. National Electrical Manufacturer Association (NEMA).
- B. Institute of Electrical and Electronic Engineers:
 - 1. ANSI/IEEE C62.11.
 - 2. C62.41.
 - 3. C62.45.
- C. Federal Information Processing Standards Publication 94 FIP PUB 94.
- D. National Fire Protection Association:
 - 1. NFPA 20.
 - 2. NFPA 70.
 - 3. NFPA 75.
 - 4. NFPA 780.
- E. UL, Inc. 1449 3rd Ed., UL 1283: MIL-STD-220A.

1.3 SYSTEM DESCRIPTION

- A. Includes electrical and mechanical requirements for a high-energy transient voltage surge suppression system. Specified system shall provide effective high energy surge current diversion, sine wave tracking for electrical line noise filtering and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments, as tested by ANSI/IEEE C62.11, C62.45 and MIL-STD-220A.
- B. Connect system in parallel with protected system; no series connected elements used which limit load current or kVA capability.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 01 33 00 "Submittal Procedures."
- B. Provide dimensions and materials of each component. Include isolation switch data.
- C. Documentation of specified system's UL 1449 Listing and clamping voltage ratings of all protection modes shall be included as required product data submittal information.

- D. Include documentation of specified system's UL 1283 Complimentary Listing as required product data submittal information.
- E. Independent fuse coordination tests from a recognized Nationally Independent Testing Laboratory.

1.5 PROJECT CLOSEOUT SUBMITTALS

- A. Manufacturer shall furnish an installation manual with installation, start up, trouble-shooting guide and operating instructions for the specified system.
- B. Electrical and mechanical drawings provided by manufacturer showing unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
- C. Record actual location of SPD.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of SPD equipment with minimum 5 years' experience.

1.7 REGULATORY REQUIREMENTS

- A. Product Listing: UL listed under UL 1449 (Rev 09/2009) Standard for SPD and surge ratings permanently affixed to SPD.
- B. Complimentary listed to UL 1283 Standard for EMI/RFI Facility Filters.

1.8 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Verify all connections are properly bonded.

1.9 WARRANTY

- A. Manufacturer shall provide a full five-year warranty from date of shipment against any failure when installed in compliance with manufacturer-written instructions, UL listing requirements, and any applicable national or local electrical codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton;
- B. Erico Critec;
- C. Maxivolt Corp;
- D. Approved equal.

- E. All manufacturers shall submit independent test data from a recognized Nationally Testing Laboratory for over current protection, protection modes, and compliance with UL 1449 ratings.

2.2 ENVIRONMENTAL REQUIREMENTS

- A. Storage temperature range shall be -67 to +187 degrees F.
- B. Operating temperature range shall be -40 to +122 degrees F.
- C. Operation shall be reliable in an environment with 0- to 95-percent non-condensing relative humidity.
- D. SPD shall not generate any appreciable audible noise.
- E. Unit shall not generate any appreciable magnetic fields and shall be suitable for use directly inside computer rooms.

2.3 ELECTRICAL REQUIREMENTS

- A. Nominal system operating voltage shall be 277/480, three-phase WYE, four-wire plus ground.
- B. Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent nominal system operating voltage to ensure ability of system to withstand temporary RMS overvoltage (swell) conditions.
- C. Operating frequency range of the system shall be at least 47 to 63 Hertz.
- D. All protection modes (including Neutral to Ground) of SPD shall be internally fused at component level with fuses IxIxT capability to allow suppressor's maximum rated transient current to pass through suppressor without fuse operation. If rated IxIxT characteristic of fusing is exceeded, fusing is capable of opening in less than one millisecond and clear both high and low impedance fault conditions. Fusing shall be able to interrupt up to 100-kA symmetrical fault current with 600 VAC applied. This overcurrent protection circuit shall be monitored and provide indication of suppression failure/operability. Conductor level fuses or circuit breakers internal or external to SPD not acceptable. Contractor to furnish submittal documentation of proper fuse coordination of actual fault tests from a recognized Nationally Testing Laboratory for product approval.
- E. SPD unit shall be supplied with factory-installed disconnect and overcurrent protection device that eliminates requirement for external fusing.

2.4 PROTECTION MODES

- A. Protection Modes:
 - 1. Line-to-Neutral Protection.
 - 2. Neutral-to-Ground Protection.
 - 3. Line-to-Ground Protection.
 - 4. Line-to-Line Protection.
- B. SPD surge current capacity shall be 240 kA per phase.
- C. SPD system shall provide a joule rating that meets or exceeds requirements of ANSI/IEEE C62.41 Category C delivery capability.
- D. Typical response time of all suppression components shall be less than one nanosecond.

2.5 SURGE SUPPRESSION COMPONENTS

- A. TVSS unit shall display combined total number of transient voltage surges detected from L-N, L-G, N-G, and L-L since counter was last reset.
- B. Provide dry contacts to monitor ON/OFF and alarm status.
- C. Alarm silence, reset, and test functions.
- D. Indication of full or partial loss of protection.
- E. Individually fused suppression modules.
- F. AC Tracking Filter: EMI/RFI filtering up to -50dB from 100 kHz to 100 MHz.
- G. Unit to include isolation switch, module status indicator lights, form C summary alarm contact.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. SPD shall be installed as a Type 2 device.
- B. Contractor shall follow SPD manufacturer-recommended installation practices and comply with all applicable codes.
- C. Manufacturer shall furnish an installation manual with installation, start up, trouble-shooting guide and operating instructions for the specified system.
- D. Electrical and Mechanical Drawings shall be provided by the manufacturer, which show unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagram.
- E. No sharp bend allowed in wiring from SPD unit to ground.
- F. Install SPD so wiring between SPD and Point of Connection is minimal.

END OF SECTION

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparing subgrades for pavements.
 - 2. Subbase course for concrete pavements.
 - 3. Excavating and backfilling trenches.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 DEFINITIONS

- A. Backfill: Soil used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 FIELD CONDITIONS

- A. Do not commence earth-moving operations until plant-protection measures specified in Section 01 56 39 "Temporary Tree and Plant Protection" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Liquid Limit: 30.
 - 2. Plasticity Index: 5-12.
- C. Unsatisfactory Soils: Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: NTxDOT Item 247, Type A, Grade 2 or better, Maximum Aggregate Size: 2 inches, Maximum Liquid Limit: 30, Plasticity Index: 5-12.
- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

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 earth-moving operations.

- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR PAVEMENTS

- A. Excavate surfaces under pavements to indicated lines, cross sections, elevations, and subgrades.

3.4 EXCAVATION FOR TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Trench Bottoms: Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- C. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 - 3. Cut and protect roots according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

3.5 SUBGRADE INSPECTION

- A. Proof-roll subgrade with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2,500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade.
 - 2. Removing concrete formwork.
 - 3. Removing trash and debris.
 - 4. Removing temporary shoring, bracing, and sheeting.
 - 5. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.9 TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 32 13 13 "Concrete Paving."
- D. Initial Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 2 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.10 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS

- A. Place backfill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:
 - 1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. For trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.12 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

3.13 SUBBASE AND BASE COURSES UNDER PAVEMENTS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements as follows:
 - 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections:
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.15 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete Paving, including the following:
 - a. Roadways.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of product, ingredient, or admixture requiring color selection.
- C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I, or Type III for cold weather.
 - 2. Fly Ash: ASTM C 618.
- B. Air-Entraining Admixture: ASTM C 260/C 260M.
- C. Water: Potable and complying with ASTM C 94/C 94M.

2.4 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
- B. Cementitious Materials:
 - 1. Fly Ash or Pozzolan: 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 5-1/2 percent plus or minus 1-1/2 percent.
- D. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 3,500 psi
 - 2. Maximum W/C Ratio at Point of Placement: 0.50.

2.5 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Contraction Joints (Control Joints): Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Sidewalks, slabs, curbs, gutters, and stairs:
 - a. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - 2. Ramps:
 - a. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16- to 1/8-inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

- B. Comply with ACI 306.1 for cold-weather protection.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4-inch.
 - 2. Thickness: Plus 3/8-inch, minus 1/4-inch.
 - 3. Surface: Gap below 10 feet long; unlevelled straightedge not to exceed 1/2 inch.
 - 4. Joint Spacing: 3 inches.
 - 5. Contraction Joint Depth: Plus 1/4-inch, no minus.
 - 6. Joint Width: Plus 1/8-inch, no minus.

3.10 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 84 00 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Piping.
 - 2. Manual valves.
 - 3. Automatic control valves.
 - 4. Transition fittings.
 - 5. Miscellaneous piping specialties.
 - 6. Sprinklers.
 - 7. Controllers.
 - 8. Boxes for automatic control valves.
- B. Related Requirements:
 - 1. Division 01 Specification Sections apply to Work of this Section.

1.2 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. ET Controllers: EvapoTranspiration Controllers. Irrigation controllers which use some method of weather based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET; broadcasting of ET measurements; or use of on-site sensors to track ET.
- D. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 200 psig.
 - 2. Lateral / Circuit Piping: 150 psig.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- B. Qualification Data: For qualified Installer.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers controllers and automatic control valves to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spray Sprinklers: Equal to 2 percent of amount installed for each type and size indicated, but no fewer than 10 units.
 - 2. Bubblers: Equal to 2 percent of amount installed for each type indicated, but no fewer than 5 units.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers that include a Licensed Irrigator by the State of Texas.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; SDR 11.5 SDR 15.
 - 1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.
- C. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40.
 - 1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- D. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21.
 - 1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
 - 2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

- A. Plastic Ball Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer Inc.
 - e. Hayward Flow Control; a division of Hayward Industries, Inc.
 - f. IPEX USA LLC.
 - g. Jomar Valve.
 - h. KBI (King Bros. Industries).
 - i. Legend Valve & Fitting, Inc.
 - j. NIBCO INC.
 - k. Sloane, George Fischer, Inc.
 - l. Spears Manufacturing Company.
 - m. Thermoplastic Valves, Inc.
 - n. Watts; a Watts Water Technologies company.

2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig.
 - c. Body Material: PVC.
 - d. Type: Union.
 - e. End Connections: Socket or threaded.
 - f. Port: Full.
- B. Bronze Gate Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Valve, Inc.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Hammond Valve.
 - d. Jenkins Valves; Crane Energy Flow Solutions.
 - e. KITZ Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Watts; a Watts Water Technologies company.
 - j. Zurn Industries, LLC.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. Class: 125.
 - c. CWP Rating: 200 psig.
 - d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
 - e. Ends: Threaded or solder joint.
 - f. Stem: Bronze, nonrising.
 - g. Disc: Solid wedge; bronze.
 - h. Packing: Asbestos free.
 - i. Handwheel: Malleable iron, bronze, or aluminum.

2.4 AUTOMATIC CONTROL VALVES

- A. Bronze, Automatic Control Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Rain bird Corporation.
 2. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.
- B. Plastic, Automatic Control Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Rain Bird Corporation.
 2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 TRANSITION FITTINGS

- A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
- B. Transition Couplings:
 - 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. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries, Inc.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
- C. Plastic-to-Metal Transition Fittings:
 - 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. Harvel Plastics, Inc.
 - b. Spears Manufacturing Company.
 - c. Insert manufacturer's name.
 - 2. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
 - 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. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 - 2. Description: MSS SP-107, PVC four-part union. Include one brass threaded end, one solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.6 MISCELLANEOUS PIPING SPECIALTIES

- A. Pressure Gages: ASME B40.1. Include 4-1/2-inch-diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.7 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Rain Bird Corporation.

2. Description:
 - a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 3. Capacities and Characteristics:
 - a. Flow: As indicated on plans.
 - b. Pop-up Height: 4 inches aboveground to nozzle.
 - c. Arc: Full circle.
 - d. Radius: As indicated on plans.
 - e. Inlet: NPS 1 inch.
- C. Plastic, Pop-up Spray Sprinklers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Rain Bird Corporation.
 2. Description:
 - a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - e. Pattern: Fixed, with flow adjustment.
 3. Capacities and Characteristics:
 - a. Nozzle: ABS.
 - b. Flow: As indicated on plans.
 - c. Pop-up Height: 4 inches aboveground to nozzle.
 - d. Arc: As indicated on plans.
 - e. Radius: As indicated on plans.
 - f. Inlet: NPS 1/2.

2.8 CONTROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide A2C-75D-M or comparable product by one of the following:
 1. Hunter Industries Incorporated.
- B. Description:
 1. The controller shall be a full-featured commercial-industrial product for the purpose of irrigation management and monitoring of control valves, flow, and sensors, via two-wire decoder connections. The controller shall be a 75-station base model expandable with 75-station input modules up to 225 stations.
- C. Programming:
 1. The controller shall have 32 independent programs with unique day schedules, start times, and station run times.
 2. Each program shall allow Day of Week, Interval, or Odd/Even schedule types.
 3. Each program shall offer up to 10 start times.
 4. Each program may be allowed to overlap, stack, or SmartStack to a user-specified maximum number of simultaneous programs.

5. Each program may have programmable Non-Water Windows, during which automatic irrigation will not be allowed.
 - a. Missed irrigation as a result of water window violations is logged and announced as an alarm.
 - b. Manual irrigation for maintenance purposes shall not be inhibited by Non-Water Windows.
6. Programs may be configured as Automatic, Start to End, or Manual only.
 - a. Start to End programs shall cycle continuously from a start time to an end time.
 - b. Manual programs are only initiated by the user from a command, remote control, or Conditional Response statement.
7. Each station shall be programmable in hours, minutes, and seconds of run time, from 1 second to 12 hours.
8. The controller shall allow the creation of up to 64 blocks • of up to 8 stations each, used to facilitate programming and operation of larger systems.
9. The blocks may be assigned a single run time within a program, and all stations will run together as a group.
10. Each program may be assigned a programmable delay between stations, to allow for slow-closing valves or pressure recharging.
11. Each station or block may be assigned Cycle and Soak settings to prevent runoff and waste by dividing run times into absorbable increments.
12. Flow Operations:
 - a. Controller shall feature independent flow management and flow monitoring in each of up to 6 flow zones.
 - b. Controller shall allow flow budgeting at flow zone and mainline levels to monitor total monthly water usage, and provide an alarm when the budgeted amount is exceeded.
 - c. Flow management shall allow the controller to schedule simultaneous stations on within each flow zone, based on their flow characteristics, to reach a user-programmable rate of flow for the duration of the water window.
 - d. Flow operations shall also include the ability to assign a separate flow sensor and master valve to the mainline level, above the independent flow zones, to monitor and protect long runs of mainline pipe.
 - e. The controller shall permit the creation of Conditional Response statements, permitting sensor inputs or other conditions to trigger pre-programmed actions on the part of the controller.
13. The controller shall feature a separate decoder diagnostic menu with functions to:
 - a. Program decoders.
 - b. View status or configuration of individual decoders.
 - c. Assign stations from one decoder output module to another.
 - d. Create a decoder inventory.
 - e. Perform diagnostic tests and display current draw for all components of the two-wire system.
14. The controller shall include a built-in wire tracking function, that generates a traceable sine wave on the two-wire path for use with standard current clamp meters to locate line faults.
15. The controller shall include a solenoid finder feature, to chatter solenoids for up to 30 minutes to facilitate finding lost valve boxes in the landscape.

- D. Decoders:
1. ICD Decoders are compatible with ACC2 Decoder Controllers and legacy ACC-99D Decoder Controllers
 2. 1-, 2-, 4-, and 6-station versions provide maximum flexibility.
 3. Sensor decoders allow flow and Clik sensor monitoring via the two-wire paths.
 4. Field-programmable decoders accept station numbers directly, and do not require entering serial numbers into the control panel.
 - a. Decoders can be programmed before installation at the controller interface.
 - b. Wireless programming with ICD-HP allows for decoder programming or re-programming after installation to the two-wire path
 5. Industrial-grade DBRY-6 waterproof connectors included for two-wire path splices.
 6. Decoder models:
 - a. ICD-100 (Single station), ICD-200 (2 station), ICD-400 (4 Station), ICD-600 (6 Station), ICD-SEN (2 input sensor decoder with surge suppression and ground wire).
 7. Decoder wire shall be Hunter ID1 WIRE: Two-conductor, solid-core, twisted, color-coded red and blue, direct burial PE jacket 14AWGdia. copper wires. Suitable up to 5000 feet., or ID2 WIRE: Two-conductor, solid-core, twisted, color-coded red and blue, direct burial PE jacket 12AWGdia. copper wires. Suitable up to 7,500 feet.
 - a. Each two-wire output run of wire is called a "path." Decoders may be installed on any or all of them in any combination.
 - b. It is not necessary to connect the paths to one another. Each path runs from the controller to the last decoder in the path, and simply stops there.
 - c. Never connect a wire path from one controller to the wire paths from another controller.
 - d. Hunter requires twisted wire meeting the listed specifications on all paths. The twist in the wire is an essential part of surge suppression. Color coding the two different conductors is mandatory.
- E. Irrigation Management Platform:
1. The Centralus Irrigation Management Platform from Hunter Industries shall consist of cloud-based control software capable of remote monitoring and management of compatible Hunter commercial irrigation controllers via Wi-Fi, Ethernet (LAN), or 4G LTE cellular connections.
 2. The central control software shall be accessible via internet browser and display the activity of all managed controllers in list and/or map overviews.
 3. All controllers shall be visible on a live, online map and located automatically based on the user-supplied controller addresses.
 - a. The map shall be selectable between street, satellite, or terrain views.
 - b. The map shall automatically size to the extents of the controller locations to show all controllers, and users may zoom, pan, and navigate freely throughout the map for controller selection purposes.
 4. The central control software shall permit selection of any controller, and then offer full remote programming of all controller features in the browser, including irrigation scheduling, controller settings, and weather-based watering adjustments.
 5. The central control software shall allow the user full remote-control capabilities, including starting and stopping individual stations and programs, or setting the controller to Off for a user-defined number of days. The system shall also allow quick adjustment of irrigation amounts by a percentage value.

6. The central control software shall be compatible with locally installed smart weather adjustment sensors, which can adjust each controller's irrigation schedule automatically based on local climate conditions. The software shall also report controller shutdowns due to active rain, freeze, soil moisture, or other sensors.
 7. The central control software shall display the forecast weather for each controller several days in advance and shall enable automatic shutdowns of irrigation when the forecast temperature or chance of rainfall exceed a user-specified threshold.
 8. The central control software shall have multi-user permissions for maintenance organizations, where each controller shall have a designated owner who may then grant control access for specified controllers to other authorized personnel by email address.
 9. The central control software shall automatically alert owners and/or designated crewmembers via SMS text messages when selected alarms occur at a controller location, indicating the controller and the type of alarm for rapid response or repair.
 10. The central control software shall detect any settings or scheduling conflict between the software and the controller hardware and shall alert the user if a conflict is detected. The software shall have the ability to identify and display any conflicts and allow the user to decide which settings shall be used.
 11. Irrigation controllers shall be connected to the internet and central control software via 2.4 GHz Wi-Fi, Ethernet (LAN), or 4G LTE cellular communications.
 - a. Wi-Fi connections shall conform to 802.11 b/g/n standards with all necessary approvals and compliance for 2.4 GHz wireless devices and shall include an approved antenna.
 - b. Ethernet connections shall be standard RJ-45 hardwired jack to the network via approved cable (CAT 5, CAT 5e, CAT 6, or equal).
 12. The irrigation controllers shall be supplied by the same manufacturer of the central control software and warranted for use together as a complete system.
 - a. The controller manufacturer shall offer a range of models that are suitable for different applications, including economical controllers with up to 54-station capacity, and heavy-duty controllers with up to 225-station capacity.
 13. The controllers shall include water-saving features such as cycle and soak, delay between stations, rain sensor inputs with automatic shutdown, and manual or automated Seasonal Adjustment.
 - a. Advanced ACC2 Controllers shall also include built-in flow monitoring ability with multiple master valves to monitor up to 6 flow zones.
 14. The controllers must also be compatible with a local, license-free remote control that is independent of internet connectivity, Hunter Industries models ROAM and ROAM-XL.
 15. The software shall be Centralus Irrigation Management Software, as offered by Hunter Industries.
 - a. The Wi-Fi communications module for heavy-duty ACC2 Controllers as listed below shall be Hunter Industries model A2C-WIFI.
 - b. The Ethernet (LAN) communication module for heavy-duty ACC2 Controllers as listed below shall be Hunter Industries model A2C-LAN.
- F. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
- a. The enclosure shall be powder-coated 16-gauge G90 galvanized steel, with approximately 5 mil coating.
 - b. Mounting: Surface type for wall.
 - c. Controller shall feature a pre-wired external SmartPort connector for remote control, protected from the elements with a tethered rubber cap.

- d. Wall mount enclosure and installed equipment shall carry a conditional 5 year manufacturer's warranty.

2.9 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Plastic Boxes:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Rain bird Corporation.
 2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: As required for valves and service.
 - b. Shape: Rectangular.
 - c. Sidewall Material: PE.
 - d. Cover Material: PE.
 - 1) Lettering: "IRRIGATION."
- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4-inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Provide minimum cover over top of underground piping according to the following:
 1. Irrigation Main Piping: Minimum depth of 18 inches below finished grade, or not less than 6 inches below average local frost depth, whichever is deeper.
 2. Lateral / Circuit Piping: 12 inches.
 3. Sleeves: 24 inches.

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774.

- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install ductile-iron piping according to AWWA C600.
- L. Install PVC piping in dry weather when temperature is above 40 degrees F. Allow joints to cure at least 24 hours at temperatures above 40 degrees F before testing.
- M. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- N. Install piping in sleeves under parking lots, roadways, and sidewalks.
- O. Install sleeves made of Class 200PVC pipe and socket fittings, and solvent-cemented joints.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
 - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- J. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

- A. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
 - 1. Install valves and PVC pipe with restrained, gasketed joints.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

3.7 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on wall.
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.9 IDENTIFICATION

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 31 20 00 "Earth Moving" for warning tapes.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Any irrigation product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that controllers are installed and connected according to the Contract Documents.
 - 3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.12 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2-inch above, finish grade.

3.13 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.14 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves controllers.

3.15 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
- C. Aboveground irrigation main piping, NPS 4 and smaller, shall be the following:
 - 1. Schedule 40, PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
- D. Aboveground irrigation main piping, NPS 5 and larger, shall be the following:
 - 1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
- E. Underground irrigation main piping, NPS 4 and smaller, shall be the following:
 - 1. NPS 4 PE pressure pipe; PE butt, heat-fusion or socket-type fittings; and heat-fusion joints.
 - 2. Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.
- F. Underground irrigation main piping, NPS 5 and larger, shall be one of the following:
 - 1. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
- G. Lateral / Circuit piping, NPS 2 and smaller, shall be the following:
 - 1. Class 200 SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
- H. Lateral / Circuit piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Class 200 SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

- I. Underground Branches and Offsets at Sprinklers and Devices:
 - 1. Plastic or poly swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

3.16 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:
 - 1. NPS 2 and Smaller: PVC ball valve.
 - 2. NPS 3 and Larger: Bronze gate valve, resilient seated; iron gate valve casing; and operating wrench(es).

END OF SECTION

SECTION 40 73 29 – DIFFERENTIAL PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for transmitters.
- B. Related Sections:
 - 1. Division 01 Specification Sections apply to Work of this Section.
 - 2. Section 40 70 00 “Instrumentation for Process Systems.”

1.2 REFERENCES

- A. This section contains a reference to NEMA 250-85 - Enclosures for Electrical Equipment. They are a part of this Section as specified and modified. In case of conflict between requirements of this Section and those of noted document, requirements of this Section will prevail.

PART 2 - MATERIALS

2.1 GENERAL REQUIREMENTS

- A. Unless otherwise specified, measuring elements, transmitters, and process switches comply with the following requirements:
 - 1. Transmitters shall be two-wire type with operating power derived from signal transmission circuit, unless otherwise specified.
 - 2. Transmitter output shall be 4 to 20 mA, current regulated, and drive any 0 to 550-ohm load with power supply at 23 volts DC.
 - 3. Transmitters shall meet specified performance requirements with load variations within 0 to 600 ohms with power supply at 24 volts DC.
 - 4. Transmitter output shall be galvanically isolated.
 - 5. Transmitters output shall increase with increasing measurement.
 - 6. Transmitters enclosures shall be rated NEMA 250, Type 4, unless otherwise specified.
 - 7. Provide transmitters located outdoors with surge protectors MTL Inc. SD series with replaceable fuse and disconnect features, or equal.
 - 8. When two-wire transmitter is located where classified as hazardous, make safe by an intrinsic safety barrier.
 - 9. Where four-wire transmitters are permitted, provide with loop powered signal current isolator connected in output signal circuit.

2.2 PRESSURE-INDICATING TRANSMITTER (PIT)

- A. Identification: PIT.
- B. Function: Level Determination.
- C. Description: Gauge Pressure Measurement.

- D. Power supply:
 - 1. 24VDC.
 - 2. 10.5 to 55 VDC, with no load.
- E. Signal Input: Process.
- F. Pressure Range: 0 to ### PSIG. Range as site specific; see Drawings.
- G. Signal Output: 4 to 20mA.
- H. Process Connection: 1/2-inch NPT Female.
- I. Isolating Diaphragm: 316L SST.
- J. Process Wetted Parts: 316L SST.
- K. Wetted O-Rings: Glass-filled PTFE.
- L. Fill Fluid: Silicone.
- M. Housing Material: Polyurethane-covered Aluminum.
- N. Conduit Entry Size: 1/2-inch – 14 NPT.
- O. Indication: Five-digit LCD display.
- P. Temperature Limit: Process -40 to +250 degrees F.
- Q. Transmitter Requirements:
 - 1. Autrol APT3100 series pressure transmitter or approved equal.
 - 2. Two-wire, capacitance high-performance gage pressure transmitter.
 - 3. Configured assembled to integral manifold of same manufacturer. Manifold shall be made of 316L stainless steel and provide a 1/2-inch NPT male process connection and proper manufacturer instrument connection. Manifold shall possess two valves, one for isolating transmitting instrument and one to allow process isolation from transmitter for calibration purposes.
 - 4. Configuration stored in nonvolatile EEPROM memory.
 - 5. Outputs to be 4 to 20mA analog signal, user-selectable linear or square root, with a superimposed digital signal. Analog output to be adjustable remotely with field communicator or control system. Zero and span adjustments also available on the transmitter.
 - 6. Provided with mounting optional manufacturer mounting hardware.
- R. Installation:
 - 1. Install per manufacturer's instructions and recommendations.
 - 2. Root valves provided at all process pressure taps. Gauge valves provided at instrument where instrument is not within sight of root valve or two or more instruments connected to single tap. Safety instruments not connected to same process tap as instruments used for control, indication, or recording. Unless otherwise specified, locate pressure instruments as close as practical to process tap but positioned to permit observation and maintenance.
 - 3. Pressure instruments not supported from process piping.
 - 4. Contractor shall furnish and install miscellaneous installation hardware (isolation valves, mounting brackets) as indicated on Drawings and recommended by manufacturer's installation instructions.

2.3 PIT - PRESSURE-INDICATING TRANSMITTER

- A. Identification: PIT.
- B. Function: Level Determination.
- C. Description: Submersible Pressure.
- D. Power Supply: 11 to 28 VDC.
- E. Signal Input: Process (Submerged).

- F. Analog Output:
 - 1. 4 to 20 mA.
 - 2. Range Analog: 4.0 to 20.0 mA.
 - 3. Pressure Range: Relative 0 to 40 feet W.C.
- G. Accuracy Static: Standard ± 0.25 percent FS.
- H. Load Resistance: $>4k$ ohm.
- I. Operating Temp: -10 to +60 degrees C.
- J. Wetted Materials: 316L stainless steel.
- K. Cable: Polyethylene.
- L. Level Units: Feet.
- M. Product Requirements:
 - 1. Pressure transmitter shall be KELLER America Level Gauge Series, or approved equal.
 - 2. Performance of PIT shall not be process dependent.
 - 3. Cable from transducer as specified by pressure transmitter manufacturer and provided by Contractor. To include cable hanger, bellows assembly, and stabilizing weight.
 - 4. Operate transmitter as a two-wire, 4 to 20 mA device, 11 to 28 VDC. 4 to 20 mA output.
 - 5. Unless noted otherwise, spare parts for equipment includes:
 - a. One set of manufacturer-recommended spare parts.
 - b. Extra operation manuals as required.
- N. Installation:
 - 1. Install per manufacturer's instructions.
 - 2. Contractor provides all necessary hardware for proper installation of level transmitter and transducer.

PART 3 - EXECUTION

3.1 PAYMENT

- A. Payment made for all Work covered in this Section at Contract unit price per unit or included in lump sum price per job for items, as shown on Proposal. Either such payment shall be complete compensation for complete performance of Work per Drawings and Specification provisions.

END OF SECTION