

CHAPTER TWO

**DETAILED
SPECIFICATIONS**

CHAPTER TWO
DETAILED SPECIFICATIONS
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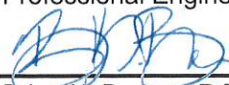

BIDDING REQUIREMENTS, CONTRACT DOCUMENTS, AND SPECIFICATIONS
FOR

2023 MWTP CHEMICAL FEED IMPROVEMENTS
DES MOINES WATER WORKS

12223 SW MAFFITT LAKE ROAD
BLOOMFIELD TOWNSHIP, IOWA
DMWW PROJECT NO. 546-547

MEC PROJECT NO. 2022001857
DMWW PROJECT NO. 546-547

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p> </p> <hr/> <p>Trenton Walter Wilson, P.E. No. P27991 (Date)</p> <p>My license renewal date is December 31, 2024</p> <p>Pages covered by this Seal: Chapter 2 – Detailed Specifications: Divisions 1-9 and 31-46.</p>
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	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p> </p> <hr/> <p>Brian K. Brewer, P.E. No. P13682 (Date)</p> <p>My license renewal date is December 31, 2023</p> <p>Pages covered by this Seal: Chapter 2 – Detailed Specifications: Division 26</p>
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DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 10 00

SUMMARY OF WORK

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PART 1 – GENERAL

1.1 CONTRACT DESCRIPTION

- A. The work under this contract includes, but is not limited to, the furnishing of all labor materials, tools, equipment, transportation, permits, certificates, and temporary protection necessary for, or incidental to, the execution of the following:
 - 1. Construction of powdered activated carbon dust collector equipment, including removal of existing soda ash dust collector equipment, and related appurtenances;
 - 2. Construction of powdered activated carbon feed equipment, including removal of existing soda ash feed equipment, process piping, and related appurtenances;
 - 3. Installation of approximately 340 linear feet of new 2" carbon slurry piping and related appurtenances;
 - 4. Removal and reconstruction of 94" x 94" CMU knock out wall, and related appurtenances;
 - 5. Replacement of ferric chloride bulk storage tanks, header piping and chemical feed skid, and related appurtenances;
 - 6. Installation of approximately 1,050 linear feet of new 1" diameter ferric chloride piping, and related appurtenances;
 - 7. Installation of approximately 840 linear feet of new 4" diameter ferric chloride piping, and related appurtenances;
 - 8. Construction of a precast ferric chloride feed piping maintenance structures and associated electrical components;
 - 9. All other work as required by the contract documents.

- B. Bid Alternate No. 1:
 - 1. Removal and replacement of existing powdered activated carbon volumetric mixing equipment as indicated in Drawings, including volumetric mixer, rotary air lock valve, knife gate valve, bin discharger, and related appurtenances.
- C. Bid Alternate No. 2:
 - 1. Application of approximately 860 square feet of Silikal 62 SLF polymer coating as indicated on Drawings, including surface preparation, vapor treatment, primer, patching and contouring for drainage slope, and applying top coat and related appurtenances.
- D. The Contractor shall be responsible for scheduling and coordinating the work for all trades (other contractors and sub-contractors) under this contract.
- E. It is the intent of this Project that the Owner be provided complete systems, functioning as required and meeting the requisites of all Federal, State, or local codes and regulations. The Contractor shall be responsible for compliance with the intent of the contract drawings and specifications.
- F. Liquidated Damages, in the amount of Five Hundred Dollars (\$500.00) per consecutive calendar day, will be assessed for each calendar day that improvements remain incomplete after the end of the Contract period, with due allowances for extensions to the contract period pursuant to provisions of the Contract Documents.

Liquidated damages will not be assessed if Substantial Completion of the Project occurs prior to the completion date for the Contract and remaining work consists only of minor clean-up and surface restoration.

1.2 PRE-BID CONFERENCE

- A. A pre-bid conference for the Project will be held on **October 10th, 2023 at 10:00 a.m. at the L.D McMullen Treatment Plant at 12223 SW Maffitt Lake Rd., Cumming, IA 50061.** Attendance at the pre-bid conference is encouraged but not required.

1.3 MEASUREMENT AND PAYMENT

- A. Owner will make monthly partial payments based on work and labor performed and materials furnished as specified under Section 1.9-4 of General Provisions and Covenants.
 - 1. Lump sum items will not be measured.
 - 2. Items not listed as specific bid items will not be measured and will be considered as incidental items. Pay for incidental items shall be included in unit bid payments.
- B. Alternates: See Section 9 of Chapter 1 for Measurement and Payment procedures.
 - 1. Alternates are defined in Section 01 25 00; provide lump sum amount. If alternates are accepted, incorporate into the Schedule of Values for each trade.
- C. Owner will accept Work and make final payment to Contractor when:
 - 1. Engineer has certified that improvements constructed by Contractor are satisfactory and conform to Plans and Specifications.
 - 2. Contractor has filed with Owner all documents called for in Specifications.
 - 3. Owner may require Contractor to submit:
 - a. Documentation that no sales or use tax was paid for any building materials, supplies, or equipment used in the performance of the Contract.

- b. Iowa Department of Revenue Form 35-002a from Contractor and each subcontractor to whom a portion of the Contract has been sublet, assigned, or otherwise disposed if sales or use tax has been paid.
- D. Acceptance and final payment will be as specified under Section 1.9-6 of General Provisions and Covenants.

1.4 QUALITY CONTROL

- A. Secure and pay for, as necessary, for proper execution of work, and as applicable at the time of the receipt of bids.
 - 1. Permits
 - 2. Government Fees
 - 3. License
- B. Comply with codes, and ordinances, rules regulations, orders and other legal requirements of public authorities, which bear on the performance of the Work.
- C. Give required notices as defined by the Contract Documents. Exceptions to this are not allowed.
- D. Promptly submit written notice to Engineer of observed variance of Contract Documents from legal requirements. Assume responsibility for work known to be contrary to such requirements, without notice.
- E. Enforce strict discipline and good conduct and order among employees. Do not employ on the work:
 - 1. Unfit persons
 - 2. Persons not skilled in assigned tasks.

1.5 CONTRACTOR'S USE OF SITE

- A. Confine operations at site to areas permitted by:
 - 1. Law and ordinance;
 - 2. Permits and Easements;
 - 3. Contract Documents
- B. Do not unreasonably encumber the site with materials and equipment. Move any stored products and materials, which interfere with the operations of the OWNER, or other contractors.
 - 1. Assume full responsibility for protection and safety off and on premises.
 - 2. Assume full responsibility for sanitary facilities for employees.
- C. Limit use of site to allow:
 - 1. Work of other Contractors as designated on Drawings.
- D. Utility outages and shutdown:
 - 1. Coordinate and schedule electrical and other utility outages with Owner.
- E. Construction plan: Before start of construction, submit three copies of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.6 WORK SEQUENCE

- A. Due to requirements of the State of Iowa, Department of Natural Resources, U.S.

Environmental Protection Agency, and Polk County, the existing water treatment facilities must be maintained in operation during construction. Contractor is to provide temporary piping and any other unspecified work to insure that the required degree of treatment during construction be equal to or exceed treatment standards of the existing facility. Project may be constructed in stages to accommodate Owner's use during construction.

- B. Construct Work in phases in order to accommodate Owner's occupancy requirements and to keep water treatment infrastructure operational during construction period. Coordinate construction schedule and operations with Engineer, and Owner. A probable sequence of construction is included for information only.
1. Construction activities can be performed simultaneously.
 2. Powder Activated Carbon Feed Improvements.
 - a. Construction of the dust collector and volumetric mixing equipment can be completed at any time with minimal impact on the City's water treatment system.
 - b. Installation of carbon slurry piping can be completed at any time, but will require coordination with Owner to connect piping to volumetric mixing equipment as well as connect piping to injection point.
 2. Ferric Chloride Feed Improvements.
 - a. Stage temporary storage tanks and connect temporary bulk storage tanks to existing ferric chloride loadout piping.
 - b. Remove CMU knockout wall.
 - c. Restrict flow in fill piping to bulk storage tanks, disconnect fill piping and overflow piping.
 - d. Restrict flow from two fill piping outlets and temporarily pipe two fill outlets to the existing chemical feed skid, reusing union for cleanouts.
 - e. Drain and isolate existing bulk storage tanks.
 - f. Once all bulk storage tanks are drained, isolate existing ferric chloride header piping.
 - g. Clean and obtain certification of clean tank prior to removal of bulk storage tanks.
 - h. Remove existing bulk storage tanks, install new bulk storage tanks and tank instrumentation.
 - i. Install new ferric chloride header piping and temporarily connect header piping to new chemical feed skid.
 - j. Connect overflow piping to bulk storage tanks.
 - k. Connect fill piping to two bulk storage tanks, allow flow to two bulk storage tanks. Connect new chemical feed skid to existing feed pipe tubing.
 - i. This will require coordination with Owner to interrupt service and to install chemical feed pumps.
 - l. Connect fill piping to the remaining two bulk storage tanks.
 - m. Remove existing chemical piping and slide new chemical feed skid into place.
 - n. Permanently connect chemical feed pipe header to new chemical feed skid.
 - o. Installation of ferric chloride feed piping can be completed at any time but will require coordination with Owner to connect feed piping to diffuser piping.
 3. Sealing Vent Piping in Sodium Hypochlorite Room.
 - a. Sealing vent piping in the Sodium Hypochlorite Room can be completed at any time with minimal impact on the City's water treatment system.
 4. MWTP Chemical Feed Improvements, construction that will have major impact

on existing treatment operation and require coordination with facility operating staff:

- a. Connecting carbon slurry piping to volumetric mixing equipment or injection point.
 - i. This needs to be coordinated with Owner as the carbon feed system will be interrupted.
 - b. Removal, reconnection, replacement of ferric chloride chemical feed system:
 - i. Any interruption to ferric chloride chemical feed system needs to be completed during period of low demand and during winter months. Coordinate interruptions with Owner.
- C. Sequences listed are suggestions and are not intended to provide detailed procedures.
- D. Contractor to provide Owner and Engineer with construction sequence (schedule) prior to construction.
- E. Contractor is responsible for the details of the sequences and for ensuring continuity of Work.

1.7 OWNER OCCUPANCY

- A. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- B. Schedule the Work to accommodate Owner occupancy.
- C. The Owner recognizes the following as legal holidays in 2023:
 - a. New Year's Day January 2, 2023
 - b. Memorial Day May 29, 2023
 - c. Independence Day July 4, 2023
 - d. Labor Day September 4, 2023
 - e. Thanksgiving November 23 and 24, 2023
 - f. Christmas December 25 and 26, 2023

1.8 INTERPRETATION

- A. Report errors or ambiguities in Specifications to Engineer as soon as detected. Engineer will answer questions regarding and interpret intended meaning of Specifications.

1.9 MATERIALS TESTS

- A. All materials shall be subject to sampling, testing, inspection and rejection at site by Engineer.
- B. Refer to Section 01 40 00 Quality Requirements.
- C. Testing by third party by Owner.
- D. Incorporate no materials in Work until laboratory tests have been furnished which show materials comply with these Specifications.

1.10 UTILITIES – CHARTED AND UNCHARTED

- A. Drawings and Specifications show condition of the site based on field surveys and available utility records.

- B. Prior to beginning construction, Contractor shall contact utility companies (electric, telephone, sewer, water, cable TV) to determine the existence of utilities. Final location of the proposed improvements will be made after location of existing utilities. This may involve excavation by the Contractor to determine elevation of existing utilities.
- C. Utility companies shall have access to the project during construction to make repairs or extensions of service. No claims for additional compensation will be allowed for delays caused by such work.
- D. All Work to maintain utilities shown in the Drawings shall be considered incidental to construction regardless of the work required to maintain them.
- E. In the event uncharted utilities exist, Contractor will be compensated on a per conflict basis. An uncharted utility crossing is defined as an uncharted utility intersecting the proposed improvement at right angles or within 30 degrees of a right angle. A parallel utility conflict is defined as a utility existing parallel to the proposed improvement or crossing the proposed improvement at more than 30 degrees to a right angle.
- F. To qualify for extra compensation, the construction must require the use of shoring or other means to protect the existing uncharted utility. Contractor shall be compensated for uncharted utilities encountered, based on the number of uncharted utilities crossed or the linear feet of parallel conflicting utility. Any uncharted utility 3-inches in diameter or smaller shall be considered incidental and no compensation will be awarded (i.e., water service lines, gas services, etc.).

1.11 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.
- B. Detailed Specifications are in outline form and include incomplete sentences. Omission of words or phrases is intentional. Supply omitted words or phrases by inference.

1.12 STANDARDS AND CODES

- A. Do Work in accordance with best present-day installation and construction practices.
- B. Conform to and test materials in accordance with applicable sections of latest revisions or tentative revisions of following codes and standards unless specifically noted to contrary:
 1. Air Moving and Conditioning Association (AMCA).
 2. American Association of State Highway and Transportation Officials (AASHTO).
 3. American Concrete Institute (ACI).
 4. American Gas Association (AGA).
 5. American Gear Manufacturers Association (AGMA).
 6. American Institute of Steel Construction (AISC).
 7. American National Standards Institute (ANSI).
 8. American Plywood Association (APA).
 9. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 10. American Society for Testing and Materials (ASTM).
 11. American Standards Association (ASA).
 12. American Water Works Association (AWWA).
 13. American Welding Society (AWS).

14. Anti-friction Bearing Manufacturer's Association (AFBMA).
15. Federal Specifications (FS).
16. Hydraulic Institute (HI).
17. Institute of Electrical and Electronic Engineers (IEEE).
18. Insulated Power Cable Engineers Association (IPCEA).
19. Iowa Department of Transportation (IDOT); latest edition of Standard Specifications for Highway and Roadway Construction and Addenda.
20. Iowa Occupational Safety and Health Act of 1972 (Chapter 83, Code of Iowa 1983) (IOSHA).
21. Manual of Accident Prevention in Construction by Associated General Contractors of America, Inc. (AGC).
22. Mining Enforcement and Safety Administration (MESA).
23. National Association of Architectural Metal Manufacturers (NAAMM).
24. National Electrical Manufacturers Association (NEMA).
25. National Electrical Safety Code (NESC).
26. National Fire Protection Association, Inc. (NFPA).
27. National Fire Protection Associations National Electrical Code (NEC).
28. National Institute for Occupational Safety and Health (NIOSH).
29. National Lumber Manufacturer's Association (NLMA).
30. National Safety Council (NSC).
31. Occupational Safety and Health Act of 1970 (Public Law 91-596) (OSHA).
32. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
33. Steel Structures Painting Council (SSPC).
34. Underwriters' Laboratories, Inc. (UL).
35. West Coast Lumber Inspection Bureau (WCLB).
36. Standards and Codes of the State of Iowa and applicable local standards and codes of the Owner.
37. Other standards and codes which may be applicable to acceptable standards of the industry for equipment, materials and installation under the Contract.

1.13 GOVERNMENT REQUIREMENTS (NOT USED)

Deleted.

1.14 INSPECTION BY STATE AND FEDERAL PERSONNEL

- A. Iowa Administrative Code 567-92.9(2)f provides for site visits by Department personnel to examine all construction aspects of the project. Personnel of the Iowa DNR shall have the right to examine all construction aspects of the project, including materials and equipment delivered and stored on site for use on the project.

1.15 HISTORICAL / ARCHAEOLOGICAL FINDS

- A. If, during course of construction, evidence of deposits of historical or archaeological interest is found, Contractor shall cease operations affecting find and notify Owner, who shall notify Iowa Department of Natural Resources and Director of Historic Preservation Officer, State Historical Department, 600 East Grand, Des Moines, Iowa 50319.
- B. No further disturbance of deposits shall ensue until notification by Owner that Work may proceed. Owner will issue Notice to Proceed only after State official has surveyed find and made determination to Department of Natural Resources and Owner. Compensation to Contractor, if any, for lost time or changes in construction to avoid find, determined in accordance with changed conditions or change order provisions of Specifications.

1.16 SPECIAL CONSTRUCTION

A. DESCRIPTION

1. Procedures outlined below are not intended to fully cover all special procedures or emergencies, which may arise during construction but are offered as an aid to Contractor in planning work. Contractor will cooperate with the Owner and Engineer to minimize inconvenience, construction delays and minimize traffic interruptions.
2. Determine location of underground utilities and piping before starting work. Locations of underground appurtenances shown are approximate and not guaranteed by Owner or Engineer.
 - a. Contractor is responsible for contacting all utility companies to determine the location of existing utilities and for protection of existing utilities.
 - b. Utility companies will have access to the project to make repairs and extensions to existing utilities.
- 3.. Remove and replace all signs which interfere with construction operations. Replace damaged signs at no cost to Owner.
- 4.. Arrange with operating utilities for relocation or temporary removal of utilities in conflict with construction and for services needed during construction.
- 5.. Notify Engineer immediately if uncharted utilities are encountered during excavation. Reroute, block or replace as directed by Engineer. Authorized rerouting, blocking or replacement will be paid for as Extra Work.
- 6.. Submit complete schedule after Award of Contract for planning, controlling and completing construction of project. Include list of promised delivery dates for major equipment items. Schedule project on basis of promised delivery dates for major equipment items:
 - a. Contractor will be expected to provide adequate personnel and equipment to perform Work within specified time of construction.
 - b. If delays in delivery of major equipment become apparent, notify Owner or Engineer promptly; take action to accomplish one of the following:
 - i. Substitute alternate equipment with approval of Owner and Engineer.
 - ii. Expedite delivery of equipment.
 - c. Extensions of contract period will be given consideration upon written request of Contractor. Request must include valid supporting data and bonafide reasons for requesting extension. Inclement weather is not justification for extending contract period. Owner expects work to be complete and ready for final acceptance within completion time specified.

1.17 COOPERATION WITH OTHERS

- A. Cooperate with State and Federal regulatory agencies in matters under their jurisdiction over construction operations.
- B. Cooperate with IDNR and other local governmental agencies. Secure necessary building permits and arrange for inspections at proper times.
- C. Cooperate with Owner's staff.
- D. Advise all utilities prior to excavating:
 1. Telephone company will move or protect underground cables. Give notification 3-days before digging.
 2. Advise Owner of proposed construction schedule as it relates to electrical power, existing water, and sanitary sewer system.
 3. Advise gas supplier when working near or adjacent to the gas distribution system. If conflict occurs, notify Engineer immediately.

1.18 EASEMENTS AND CONSTRUCTION PERMITS

- A. Do all work within easements, rights-of-way, and property furnished by the Owner.
- B. Construction permit will be obtained by the Owner from the Iowa Department of Natural Resources. Owner will deliver prompt notification to Contractor once the construction permit has been received. Work that disturbs or alters treatment processes may not begin prior to receiving a construction permit from Iowa Department of Natural Resources.
- C. Grading and Site Improvement Permit must be obtained from Polk County. Permit fees are to be included in the Contractor's bid price.
- D. Electrical Permit must be obtained from Polk County. Permit fees are to be included in the Contractor's bid price.

End.

SECTION 01 25 00

SUBSTITUTION PROCEDURES

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PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Quality Assurance
- 1.3 Product Options
- 1.4 Substitution of Major Equipment Items and Products
- 1.5 Other Product Substitution Procedures

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Substitution of Major Equipment
- C. Other product substitution procedures

1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Engineer.

1.3 PRODUCT OPTIONS

- A. See Section 01 60 00 - Product Requirements.

1.4 SUBSTITUTION OF MAJOR EQUIPMENT ITEMS AND PRODUCTS

- A. The Bid Proposal Form format is based on a lump sum bid price contract using "Basis of Bid" major equipment items and products which have been identified and described in the Contract Documents. Major equipment items and products identified below are considered "Basis of Bid" items. Contract Document sections defining "Basis of Bid" major equipment items or products include:
 - 1. PAC Dust Collector
 - a. MAC Bin Vent Model 39AVRC14-13, Style 2, with MAC Model SB17 Fan (reference quotation No. 094136MAC-R2).
 - 2. PAC Volumetric Mixing Equipment

- a. Versifeeder, Vibra Screw 4-foot Bin Discharger, Vortex Global round Titan maintenance gate, carbon steel with SS blade, and Magnum Systems/Smoot FTP12-2 SAP 0.5 hp NORD gearmotor, by Vibra Screw, Inc. (reference quotation No. X-23-503).
 - 3. Vertical Bulk Storage Tanks
 - a. 3,000-gallon vertical IMFO storage tank, 41103000410, by PolyProcessing (reference quotation No. Q-108359).
 - 4. Ferric Chloride Feed Skid
 - a. Ferric Asahi/CP Feed Skid, packaged chemical feed skid provided by Vessco, Inc.
 - 5. Bid Alternate No. 1:
 - a. Versifeeder, Vibra Screw 4-foot Bin Discharger, Vortex Global round Titan maintenance gate, carbon steel with SS blade, and Magnum Systems/Smoot FTP12-2 SAP 0.5 hp NORD gearmotor, by Vibra Screw, Inc. (reference quotation No. X-23-503).
 - 5. Bid Alternate No. 2:
 - a. Silikal 62 SLF with flexible membrane.
- B. Failure to furnish the installed price of each "Basis of Bid" item may be cause for rejection of bid.
- C. It is not the intent of the Contract Documents to contain proprietary, exclusionary, or discriminatory requirements other than those based on performance. Manufacturers' who believe that their equipment can meet the performance requirements and, with the exception of minor details the technical requirements of the Contract Documents, are encouraged to submit a quotation to a Bidder for a substitute major equipment item or product. Model number designations for the major equipment items are included for information purposes. Proposed "Basis of Bid" major equipment items and "Substitute" major equipment items will be evaluated on the basis of the requirements contained in the Contract Documents.
- D. Bidder's desiring to quote a price for a substitute major equipment item or product in lieu of a "Basis of Bid" item may at their option write in the name of one manufacturer to be identified and attach product information to the Bid Proposal Form. The manufacturer listed by the Bidder shall be considered the proposed "Substitute" major equipment item or product. The Bidder shall note the installed price of each proposed "Substitute" major equipment item or product with attached product information.
- E. The Bidder shall not use the installed price for any proposed "Substitute" major equipment item or product in preparing the LUMP SUM BID PRICE.
- F. If the Bidder writes in the name of a proposed "Substitute" manufacturer and fails to note the installed price or writes in the installed price and fails to identify the name of the proposed "Substitute" manufacturer, the Bidder shall furnish the "Basis of Bid" item for the installed price noted in the Bid Proposal Form.
- G. **QUALIFICATION PACKAGE Not Used**
- H. **CONTRACT AWARD**
 - 1. If a proposed "Substitute" qualification package is accepted as "or equal" by the Engineer, the "Substitute" major equipment item or product listed in the Bid Proposal Form shall be furnished for the adjusted price, + or -, noted and the TOTAL BID PRICE shall also be adjusted accordingly.
 - 2. In the event that a proposed "Substitute" major equipment item or product is not accepted as "or equal" by the Engineer, the "Basis of Bid" major equipment item or product as specified shall be furnished for the amount noted in the Bid

3. Proposal Form and without adjustment to the TOTAL BID PRICE.
Refer to Section 1.3 of Chapter 1 for details of award of contract.

I. **SHOP DRAWING SUBMITTALS**

1. Acceptance of a proposed "Substitute" major equipment item or product "Qualification Package" or naming of "Basis of Bid" equipment does not eliminate the need for shop drawing submittals and reviews during construction, nor does it eliminate the requirement that the equipment manufacturer satisfy the requirements of the Contract Documents.
2. Shop drawings shall be furnished in accordance with Section 01 33 00.
3. Should the Bidder furnish a major equipment item or product requiring changes to the Contract Documents, he shall notify the Engineer in writing of all dimensional, mechanical, electrical and structural changes and/or requirements for the major equipment item's use in this Project and shall reimburse the Owner for any associated redesign and/or construction drawings. The Bidder shall consider all costs associated in furnishing and installing a major equipment item or product in his installed price proposal. This will include, but not be limited to, preparation and submittal of detailed shop drawings, any changes or additions in structure, piping, building, mechanical work, electrical work, accessories, control or other items required to provide a completely operating installation. Redesign and contract drawing revisions to accommodate equipment or products will be prepared by the Engineer during the shop drawing review process. Reimbursement shall be based on Engineers Standard Rate Tables.

1.5 OTHER PRODUCT SUBSTITUTION PROCEDURES

- A. For products not listed under Substitution of Major Equipment Items and Products and not identified in Part 1.4 A..
- B. Engineer will consider requests for substitutions of other items within 15 days prior to date for receipt of bids.
- C. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- D. Submit 3 copies of request for substitution for consideration.
- E. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
 3. Reference to Article and Paragraph numbers in Specification Section.
 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
 5. Changes required in other Work.
 6. Availability of maintenance service and source of replacement parts as applicable.
 7. Certified test data to show compliance with performance characteristics specified.
 8. Samples when applicable or requested.
 9. Other information as necessary to assist Engineer's evaluation.

- F. A request constitutes a representation that Contractor:
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 that may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
 6. Will reimburse Owner Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.
- G. 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.
- H. Substitution Submittal Procedure:
1. Submit requests for substitutions on form attached to end of this Section.
 2. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
 3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 4. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

End.

PRODUCT SUBSTITUTION REQUEST FORM

To: _____

Project: _____

PART 1

Specified Item: _____

PART 2

Section

Page

Paragraph

Description

The undersigned request consideration of the following:

PROPOSED SUBSTITUTION _____

Attached data includes product description, specifications, drawings, photographs, performance, and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. Proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by:

Signature: _____

Firm: _____

Address: _____

Date: _____

Telephone: _____

Attachments: _____

For use by Engineer

Authorized Authorized as noted

Not Authorized Received too late

By: _____

Date: _____

Remarks: _____

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Coordination and Project Conditions
- 1.3 Preconstruction Meeting
- 1.4 Progress Meetings
- 1.5 Pre-Installation Meetings
- 1.6 Closeout Meeting

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

- 3.1 Alteration Procedures

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Preinstallation meetings.
- E. Closeout meeting.
- F. Alteration procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- 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 operating equipment in service.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical; place runs parallel with lines of building. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
 - 1. Coordination Drawings: Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.

- D. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.
- G. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Engineer will schedule and preside over a preconstruction meeting after the Notice of Award. Engineer will prepare and distribute minutes of this meeting. Notice to Proceed may be issued at this meeting.
- B. Location of Meeting: Des Moines Water Works Office located at 2201 George Flagg Parkway, Des Moines, IA 50321.
- C. Attendance Required:
 - 1. Engineer
 - 2. Owner
 - 3. Contractor's office representative
 - 4. Contractors general superintendent
 - 5. Any subcontractor or supplier's representative whom the Contractor may desire to invite or Engineer may request
 - 6. Resident Project Representative
- D. Minimum Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
 - 5. Designation of personnel representing parties in Contract, Owner and Engineer.
 - 6. Communication procedures.
 - 7. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
 - 8. Scheduling.
 - 9. Critical Work sequencing.
 - 10. Discussion of Utility Company Issues:
 - a. Locates
 - b. Utility company presence on project
 - c. Contractors responsibilities for utilities
 - 11. Quality control and testing laboratory services.
 - 12. Construction surveying.
 - 13. Right-of-way and easements.
 - 14. Liquidated damages.
 - 15. Discussion of responsibilities during the project:
 - a. Engineer's responsibilities.

- b. Owner's responsibilities.
 - c. Contractor's responsibilities.
- E. Information to be provided by the Contractor at the preconstruction meeting:
 - 1. Project schedule.
 - 2. Projection of monthly pay estimates.
 - 3. List of subcontractors.
 - 4. List of material/equipment suppliers.
- F. Contractor: Record minutes and distribute copies to participants within two days after meeting, to Engineer, Owner, and those affected by decisions made.
- G. Discussion and coordinate of Work performed on site by other contractors.

1.4 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.
- C. Attendance Required:
 - 1. Job superintendent.
 - 2. Representatives of major Subcontractors.
 - 3. Engineer.
 - 4. Suppliers (as appropriate to agenda topics for each meeting.)
- D. Minimum Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems impeding planned progress and responsibility for correcting problems.
 - 5. Review of submittal 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. Status of public access to each portion of the site.
 - 14. Discussion of possible Change Orders.
 - 15. Review Contractors Application for Payment.
 - 16. Other business relating to Work.
- E. Contractor: Record minutes and distribute copies to participants within two days after meeting to Engineer, Owner, and those affected by decisions made.

1.5 PREINSTALLATION MEETINGS

- A. When required in individual Specification Sections, convene preinstallation meetings before starting Work of specific Section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific Section.

- C. Notify Engineer four days in advance of meeting date.
- D. Prepare agenda and preside over meeting:
 - 1. Review conditions of installation, preparation, and installation procedures.
 - 2. Review coordination with related Work.
- E. Record minutes and distribute copies to participants within two days after meeting to Engineer, Owner, and those affected by decisions made.

1.6 CLOSEOUT MEETING

- A. Schedule Project closeout meeting with sufficient time to prepare for requesting Substantial Completion. Preside over meeting and be responsible for minutes.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Representative of major subcontractors.
 - 3. Engineer.
 - 4. Owner (as appropriate to agenda topics).
- C. Notify Engineer four days in advance of meeting date.
- D. Minimum Agenda:
 - 1. Start-up of facilities and systems.
 - 2. Operations and maintenance manuals.
 - 3. Testing, adjusting, and balancing.
 - 4. System demonstration and observation.
 - 5. Operation and maintenance instructions for Owner's personnel.
 - 6. Contractor's inspection of Work.
 - 7. Contractor's preparation of an initial "punch list."
 - 8. Procedure to request Engineer inspection to determine date of Substantial Completion.
 - 9. Completion time for correcting deficiencies.
 - 10. Inspections by authorities having jurisdiction.
 - 11. Certificate of Occupancy and transfer of insurance responsibilities.
 - 12. Partial release of retainage.
 - 13. Final cleaning.
 - 14. Preparation for final inspection.
 - 15. Closeout Submittals:
 - a. Project record documents.
 - b. Operating and maintenance documents.
 - c. Operating and maintenance materials.
 - d. Affidavits.
 - 16. Final Application for Payment.
 - 17. Contractor's demobilization of Site.
 - 18. Maintenance.
- E. Record minutes and distribute to participants within two days after meeting, to Engineer, Owner, and those affected by decisions made.

PART 2 – PRODUCTS - Not Used

PART 3 – EXECUTION

3.1 ALTERATION PROCEDURES

- A. Designated areas of existing facilities will be occupied for normal operations during progress of construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.
 - 1. Perform Work not to interfere with operations of occupied areas.
 - 2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
 - 3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
- B. Materials: As specified in product Sections; match existing products with new and salvaged products for patching and extending Work.
- C. Employ skilled and experienced installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion. Comply with Section 01 70 00 - Execution and Closeout Requirements.
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- F. Remove debris and abandoned items from area and from concealed spaces.
- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.
- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to original condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Engineer for review.
- M. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Engineer for review.
- N. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- O. Finish surfaces as specified in individual product Sections.

End.

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Submittals
- 1.3 Quality Assurance
- 1.4 Bar Chart Schedules
- 1.5 Review and Evaluation
- 1.6 Updating Schedules
- 1.7 Distribution
- 1.8 Delays and Recovery

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance
- C. Bar chart schedules.
- D. Review and evaluation.
- E. Updating schedules.
- F. Distribution.
- G. Delays and Recovery

1.2 SUBMITTALS

- A. Schedule Updates:
 - 1. Overall percent complete, projected and actual.
 - 2. Completion progress by listed activity and subactivity, to within five working days prior to submittal.
 - 3. Changes in Work scope and activities modified since submittal.
 - 4. Delays in submittals or resubmittals, deliveries, or Work.
 - 5. Adjusted or modified sequences of Work.
 - 6. Other identifiable changes.
 - 7. Revised projections of progress and completion.
- B. Narrative Progress Report:
 - 1. Submit with each monthly submission of Progress Schedule.
 - 2. Summary of Work completed during the past period between reports.
 - 3. Work planned during the next period.
 - 4. Explanation of differences between summary of Work completed and Work

- planned in previously submitted report.
- 5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
- 6. Corrective action taken or proposed.

1.3 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel specializing in scheduling with two years minimum experience in scheduling construction work of complexity comparable to the Project and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.
- B. Contractor's Administrative Personnel: Two (2) years minimum experience in using and monitoring schedules on comparable Projects.

1.4 BAR CHART SCHEDULES

- A. Format: Bar chart Schedule, to include at least:
 - 1. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:
 - a. Subcontract Work.
 - b. Subcontract Work.
 - c. Major equipment design, fabrication, factory testing, and delivery dates including required lead times.
 - d. Move-in and other preliminary activities.
 - e. Equipment and equipment system test and startup activities.
 - f. Project closeout and cleanup.
 - g. Work sequences, constraints, and milestones.
 - 2. Listings identified by Specification Section number.
 - 3. Identification of the following:
 - a. Horizontal time frame by year, month, and week.
 - b. Duration, early start, and completion for each activity and subactivity.
 - c. Critical activities and Project float.
 - d. Subschedules to further define critical portions of Work.

1.5 REVIEW AND EVALUATION

- A. Participate in joint review and evaluation of schedules with Engineer at each submittal.
- B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.
- C. After review, revise schedules incorporating results of review, and resubmit within 10 days.

1.6 UPDATING SCHEDULES

- A. At a minimum revise construction schedule every 30-days to reflect changes in progress of Work.
- B. Maintain schedules to record actual start and finish dates of completed activities.
- C. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

- E. Upon approval of a Change Order, include the change in the next schedule submittal.
- F. Indicate changes required to maintain Date of Substantial Completion.
- G. Submit sorts as required to support recommended changes.
- H. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect including effects of changes on schedules of separate Contractors.

1.7 DISTRIBUTION

- A. Following joint review, distribute copies of updated schedules to Contractor's Project site file, to Subcontractors, suppliers, Engineer, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

1.8 DELAYS AND RECOVERY

- A. If at any time during project Contractor fails to complete an activity by its latest scheduled completion date, Contractor shall, within 3-working days, submit to the Engineer a written statement as to how and when work will be reorganized to return to current construction schedule.
- B. When it becomes apparent from progress evaluation and updated schedule data that milestone completion dates and/or contract completion dates will not be met, Contractor shall take some or all of the following actions:
 - 1. Increase construction staffing in such quantities and crafts as shall substantially eliminate backlog work.
 - 2. Increase number of working hours per shift, shifts per work day, work days per week, or amount of construction equipment to substantially eliminate backlog work.
 - 3. Reschedule work items to achieve concurrence of accomplishment.
- C. Under no circumstances will additional equipment or construction forces, increasing working hours or any other method, manner or procedure to return to current construction progress schedule be considered justification for contract modification or treated as acceleration.
- D. Contractors shall accept risk for delays caused by rate of progress of work to be performed under other Contract. In the event the Contractor is delayed in prosecution and completion of Work because of such conditions, Contractor shall have no claim for damages to Contract adjustment other than extension of time and waiver of liquidated damages during period of time occasioned by delay.

PART 2 – PRODUCTS - Not Used

PART 3 – EXECUTION - Not Used

End.

SECTION 01 33 00

SUBMITTAL PROCEDURES

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Definitions
- 1.3 Submittal Procedures
- 1.4 Construction Progress Schedules
- 1.5 Proposed Product List
- 1.6 Product Data
- 1.7 Shop Drawings
- 1.8 Samples
- 1.9 Other Submittals
- 1.10 Design Data
- 1.11 Test Reports
- 1.12 Certificates
- 1.13 Manufacturer's Instructions
- 1.14 Manufacturer's Field Reports
- 1.15 Warranties
- 1.16 Erection Drawings
- 1.17 Project Record Documents
- 1.18 Contractor Review
- 1.19 Engineer Review

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Use of electronic CAD files of Project Drawings
- G. Shop Drawings.
- H. Samples.
- I. Other submittals.
- J. Design data.

- K. Test reports.
- L. Certificates.
- M. Manufacturer's instructions.
- N. Manufacturer's field reports.
- O. Erection Drawings.
- P. Contractor review.
- Q. Engineer review.

1.2 **DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's and Contractor's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's and Constructor's responsive action. Submittals may be rejected for not complying with requirements.

1.3 **SUBMITTAL PROCEDURES**

- A. Transmit each submittal with Engineer-accepted form.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project; deliver electronically, copy to McClure and Des Moines Water Works.

Physical copies can be delivered to:

McClure Engineering Company
1360 NW 121st Street
Clive, IA 50325

- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Engineer review stamps.
- I. When revised for resubmission, identify changes made since previous submission.

- J. Submittals containing language imposing duties on others (such as verification of dimensions or supply of related information) inconsistent with the Contract language shall be considered null and void.
- K. Shop Drawings shall not be used as a media for inquiries for information or verification of information which must be supplied by other to Contractor. Inquiries or verification of information shall be made by separate Contractor submittal using Request for Information (RFI) process.
- L. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- M. Submittals not requested will not be recognized nor processed.
- N. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Comply with Section 01 32 16 - Construction Progress Schedule.

1.5 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit 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, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.6 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit number of copies Contractor requires, plus three copies Engineer will retain.
- C. Submit electronic submittals via email as PDF electronic files.
- D. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- E. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- F. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.7 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

- C. Sheet size: 8 ½-inch by 11-inch minimum; 36-inch by 120-inch maximum.
- D. Make submittals to Engineer promptly in accordance with approved schedule, and in such sequence as to cause no delay in Work or in work of any other contractor.
- E. Electronic Shop Drawings Will be accepted.
- F. Number of submittals required:
 - 1. Shop Drawings:
 - a. Submit electronically, copy McClure and Des Moines Water Works.
 - b. If physical copy is required; Submit number required by Contractor plus 4-copies which will be retained by Engineer.
- G. Submittals shall contain:
 - 1. Date of submission and dates of any previous submissions.
 - 2. Project title and number.
 - 3. Contract identification.
 - 4. Names of:
 - a. Contractor.
 - b. Supplier.
 - c. Manufacturer.
 - 5. Identification of product, with Specification section number and paragraph number.
 - 6. Field dimensions, clearly identified as such.
 - 7. Relation to adjacent or critical features of Work or materials.
 - 8. Applicable standards, such as ASTM or Federal specification numbers.
 - 9. Identification of deviations from Contract Documents.
 - 10. Identification of revisions on re-submittals.
 - 11. An 8-inch by 3-inch blank space for Contractor and Engineer stamps.
 - 12. Indication of Contractor's approval, initialed or signed, with wording substantially as follows:
 - 13. "Contractor represents to Owner and Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or assumes full responsibility for doing so and has reviewed or coordinated each Shop Drawing or sample with requirements of Work and Contract Documents."
 - 14. If Contract Documents include performance specifications stating required results which can be verified as meeting stipulated criteria, so further design by Contractor prior to fabrication is necessary, Shop Drawings depicting such design must be prepared under seal of professional engineer licensed in Iowa. Shop Drawing shall be signed, sealed, dated, and expiration of license date, in accordance with applicable regulations and with the following certification statement:
 - 15. "I hereby certify this engineering document was prepared by me or under my direct personal supervision and I am a duly licensed professional engineer under the laws of the state of Iowa and I accept responsibility for the adequacy of this document to meet criteria stipulated in the Contract Documents."
- H. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.

- I. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.8 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Engineer and Owner for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Owner selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.9 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 01 70 00 - Execution and Closeout Requirements.

1.10 DESIGN DATA

- A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.11 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.12 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.
- 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 Engineer.

1.13 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.14 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit report within 5 days of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.15 WARRANTIES

- A. Obtain warranties and bonds executed by responsible subcontractors, suppliers, and manufacturers, within 10-days after completion of the applicable item of Work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify that documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Submit prior to final application for payment.
- F. 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 the date of acceptance as the beginning of the warranty or bond period.

1.16 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.

- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.17 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change orders and other modifications to the contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Record actual revisions to the Work. 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 actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1 Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract Drawings.
- G. Submit documents to Engineer with claim for final application for payment.

1.18 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 - 4. Determination of accuracy and completeness of dimensions and quantities.
 - 5. Confirmation and coordination of dimensions and field conditions at Site.
 - 6. Construction means, techniques, sequences, and procedures.
 - 7. Safety precautions.
 - 8.. Coordination and performance of Work of all trades.

- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.19 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 20 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.
- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order, Field Order, or Work Change Directive.
- E. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

End.

SECTION 01 45 00

QUALITY REQUIREMENTS

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Quality Work
- 1.3 Tolerances
- 1.4 References
- 1.5 Labeling
- 1.6 Testing and Inspection Services
- 1.7 Manufacturer's Field Services
- 1.8 Material Tests

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

- 3.1 Schedule of Testing

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Testing and inspection services.
- F. Manufacturers' field services.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

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' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products 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 as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 TESTING AND INSPECTION SERVICES

- A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.
 - 1. Before starting Work, submit testing laboratory name, address, and telephone number, and names of full-time Professional Engineer and responsible officer.
- B. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by Engineer.
 - 1. Laboratory: Authorized to operate at Project location.
 - 2. Laboratory Staff: Maintain full-time Professional Engineer on staff to review services.

3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.
 - D. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.
 1. Submit final report indicating correction of Work previously reported as noncompliant.
 - E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 1. Notify Engineer and independent firm 24 hours before expected time for operations requiring services.
 2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.
 - F. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
 - G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to the Contractor.
 - H. Agency Responsibilities:
 1. Test Samples of mixes submitted by Contractor.
 2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
 3. Perform indicated sampling and testing of products according to specified standards.
 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
 6. Perform additional tests required by Engineer.
 7. Attend preconstruction meetings and progress meetings.
 - I. Agency Reports: After each test, promptly submit two copies of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:
 1. Date issued.
 2. Project title and number.
 3. Name of inspector.
 4. Date and time of sampling or inspection.
 5. Identification of product and Specification Section.
 6. Location in Project.
 7. Type of inspection or test.
 8. Date of test.
 9. Results of tests.
 10. Conformance with Contract Documents.
 - J. Limits on Testing Authority:
 1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements

- of Contract Documents.
- 2. Agency or laboratory may not approve or accept any portion of the Work.
- 3. Agency or laboratory may not assume duties of Contractor.
- 4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURER'S 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, startup of equipment, testing, adjusting, and balancing of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

1.8 MATERIAL TESTS

- A. Includes all materials tests or tests specified hereinafter.
- B. Owner to provide testing services through third party.
- C. Contractor shall provide samples of materials required for laboratory tests pay cost of all tests including transportation charges on samples.
- D. Incorporate no materials in work until laboratory tests have been furnished which show materials comply with specifications.
- E. All materials shall be subject to sampling, testing, inspection and rejection at site by Engineer.
- F. Laboratory tests for materials:
 - 1. Structural Steel: Certified copies of mill tests; ASTM A36.
 - 2. Fiberglass: Certify that laminate properties conform to specifications.
 - 3. Aluminum-alloy: Certify that properties conform to specifications.
 - 4. Cement: Bin sample for entire replacement, ASTM C150.
 - 5. Concrete Aggregates: One sample of each, ASTM C33.
 - 6. Two concrete compression cylinders from trial batch for each proposed mix, ASTM C39; test one at 7 days, one at 28 days; test random cylinders during construction.
 - 7. Reinforcing Steel: Certify that reinforcing steel conforms to ASTM A615 for grade specified.
 - 8. Cast Iron Pipe: Certify that pipe conforms to ANSI A21.6 or A21.8.
 - 9. Ductile Iron Pipe: Certify that pipe conforms to ANSI A21.51.
 - 10. Steel Pipe: Certify that pipe conforms to ASTM A53.
 - 11. Stainless Steel Pipe: Certify that pipe conforms to ASTM A312.
 - 12. Copper Tubing: Certify that pipe conforms to ASTM B88.
 - 13. Polyvinylchloride Pipe: Certify that pipe conforms to ASTM D1785 and AWWA C900
 - 14. Reinforced Thermosetting Resin Pipe: Certify that pipe conforms to ASTM D2996.
 - 15. Reinforced Concrete Pipe: Test two pieces of each diameter of each class furnished; check reinforcing size and placement; ASTM C76.

16. Vitrified Clay Pipe: Test two pieces of each diameter furnished, ASTM C301.
17. Other Pipe: Certify that pipe conforms to applicable specifications.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

3.1 SCHEDULE OF TESTING

- A. Perform tests, inspections, and other services specified in individual Specification Sections, as required by Engineer, and as follows.

- B. Soils Testing:
 1. Provide Standard Proctor in accordance with ANSI/ASTM D698 for each type of material requiring density tests.
 2. In-place density tests: Perform testing to determine compaction densities:
 - a. Beneath footings: 1 test per 50-linear feet under each exterior wall footing.
 - b. Under tanks: 1 test per 500-square feet.
 - c. Under floor slabs: 1 test per 500-square feet.
 - d. In utility or pipe trenches under hard surfaced areas, test at 1-foot above utility or pipe and at 2-foot elevation intervals to top of trench. One set of tests per road crossing or 100-feet of trench.
 - e. 15 in-place density tests on areas to receive paving at location determined by on-site RPR.
 3. Bearing Capacity: Perform sampling and investigating to determine soil bearing capacity of excavation for footings, foundations and other below grade structural components:
 - a. Beneath footings: 1 test per 50-linear feet under each exterior wall footing.
 - b. Under tanks: 1 test per 500-square feet.
 - c. Under floor slabs: 1 test per 500-square feet.
 - d. Accuracy of tests sufficient to verify conditions in preliminary soils investigation.

- C. Testing of Piping Systems:
 1. Pressure Pipe Testing:
 - a. Water test all piping after installation in accordance to AWWA C600.
 - b. Hydrostatic test:
 - 1) Flush out pipe before test to remove air. Insert taps to release trapped air.
 - 2) Test at 150-psi for 2-hours. Allowable pressure drop during test period is 5-psi.
 - c. Leakage test:
 - 3) Conduct leakage test concurrently with pressure test. Measure water loss by pumping from drum or by similar means.
 - 4) Maximum allowable leakage (L) in gallons per hour:

$$L = \frac{SD\sqrt{P}}{148,000}$$

L is the allowable leakage, in gallons per hour.
 S is the length of pipe tested, in feet.
 D is the nominal diameter of the pipe, in inches.

P is the average test pressure during the leakage test, in pounds per square inch gauge.

- 5) Provide all test pumps, test plugs, pipe, and gauges, and make all required piping connections.
- 6) Examine trench for leakage during test. Replace all defective pipe and fittings which do not pass leakage test at no cost to Owner, including cost of excavation and backfill. Repeat test until requirements have been met.

D. Gravity System Testing:

1. All sewer system components listed in this Section will be tested in accordance with these specifications including sewer mains, service lines, manholes and structures. Contractor is responsible to schedule testing of the various components of the system.
2. No additional compensation will be awarded to the Contractor for work involved in testing, repair of components not meeting acceptable test results, or retesting after repair of components.
3. Gravity piping:
 - 1) Infiltration and exfiltration:
 - 1) Contractor shall test sewers using air per ASTM C924.
 - 2) Infiltration for new sewer construction shall not exceed 200-gallons per inch diameter per mile of pipe per day, with minimum of 2-feet hydrostatic groundwater level above top of pipe at highest point.
 - 3) Provide satisfactory evidence to Engineer prior to final acceptance.
 - b. Low Pressure Air Testing:
 - 1) A low pressure air test may be used in lieu of an exfiltration test except as noted.
 - 2) Air test is not recommended when ground water elevation is 2 feet or greater above the top of the pipe, and cannot be used when ground water is greater than 6 feet above the top of the pipe.
 - 3) Use extreme care and follow safety precautions during testing operations. No one is allowed in manholes during testing.
 - 4) Clean entire line of all debris. Flush or wet line to produce consistent results.
 - 5) Plug all inlets and outlets to resist the test pressure. Special attention must be given to stoppers and laterals.
 - 6) Determine the test duration for the section being tested from the following table. This table ignores pipe length and uses the factor $0.472 \times d$, with "d" being in inches. Pressure holding time is based on average holding pressure of 3.0 psi or drop from 3.5 psi to 2.5 psi.
 - 7) Add air to the line segment being tested until the internal air pressure of the sewer line is raised to approximately 4.0 psi greater than the average back pressure of any ground water that may be over the top of the pipe. Pressure in the sewer should not exceed 5.0 psi. Allow at least 2 minutes for air pressure to stabilize.
 - 8) When pressure has stabilized and is at or above the starting test pressure of 3.5 psi, commence the test. Record the drop in pressure for the test period. The test may be discontinued when

- the prescribed test time has been completed, even though 1.0 psi drop has not occurred.
- 9) If the ground water level at the time of testing is above the pipe invert, add 0.43 psi of air per foot of water above the invert to the test air pressure range of 2.5 psi to 3.5 psi stated above.
 - 10) If the pressure drop exceeds 1.0 psi during the test period, the test will be considered to have failed. Repair and retest the line
- c. Deflection test: Perform on all flexible and semi-rigid sewer pipes. Test 30-days following final backfill:
- 1) Allowable deflection: Not greater than 5 percent.
 - 2) Test method: Mandrel having diameter equal to 95 percent of the inside diameter of pipe.
 - 3) Perform test without mechanical pulling devices.
 - 4) Does not apply to service lines.
 - 5) Failed mandrel tests shall be televised and submitted to Engineer for review. Engineer will evaluate the extent of deflection and determine the pipe section to be removed and replaced.
- d. Video Inspection:
- 1) Conduct video inspection of all sanitary sewers after all backfill and compaction operations are complete, but prior to final paving.
 - 2) Notify Engineer the day prior to inspection so Engineer Representative may be present during inspection.
 - 3) Notify the Engineer of the extent of any low spots encountered during testing.
 - 4) Camera shall be high-resolution color with adjustable focus, pan and tilt capabilities, illumination suitable to provide clear video image of the entire pipe, and produce high quality video image.
 - 5) Provide closed-circuit video equipment capable of displaying footage of distance measured to within 1% of actual distance.
 - 6) Record the inspection in color and forward recording to Engineer.
- e. Manholes shall be tested separately from sewer lines.
- E. Manhole Vacuum Testing:
1. Applicable only for new manholes isolated from connecting sewer line.
 2. Use manufactured vacuum test equipment meeting the Engineer's approval. Follow the equipment manufacturer's recommended procedures throughout, unless directed otherwise by the Engineer or these specifications.
 3. Use extreme care and follow safety precautions during testing operations. Keep personnel clear of manholes during testing.
 4. Seal all openings except manhole top access using pneumatic plugs rated for test pressures. Install plugs according to the test equipment manufacturer's recommendations.
 5. Brace pipe inverts if backfill material has not been placed around connecting pipes.
 6. Install the vacuum tester head assembly on the manhole top access, and inflate the seal.
 7. Evacuate the manhole to 5 psi or 10 inches mercury (Hg). Close the isolation valve and start the test. Record the starting time.
 8. Maintain a vacuum in the manhole for the time indicated in most recent Edition of SUDAS Standard Specifications.
 9. Test failure is indicated by vacuum loss greater than 0.5 psi or 1 inch mercury (Hg) within the minimum test time indicated in the table below for the depth and diameter of the manhole being tested.

- F. Manhole Exfiltration Testing:
10. Plug inlet and outlet of manhole with water-tight plug. Fill manhole to bottom of cone section or to 5-foot level, whichever is greater, with water and let stand for 1-hour.
 11. 48-inch diameter manholes:
 - a. After 1-hour, refill manhole to original depth.
 - b. Record difference in elevation of water surface after 1-hour.
 - c. Refill to original depth and measure volume of water added.
 - d. Allowable leakage is 0.08-gallons per foot of depth.
 12. Manholes larger than 48-inches in diameter:
 - a. After 1-hour, refill manhole to original depth.
 - b. Record difference in elevation of water surface after 1-hour and convert into gallons per hour lost through manhole leakage.
 - c. Allowable leakage:
 - 1) 54-inch Diameter: 0.088-gallons per foot of depth.
 - 2) 60-inch Diameter: 0.095-gallons per foot of depth.
 - 3) 66-inch Diameter: 0.104-gallons per foot of depth.
 - 4) 72-inch Diameter: 0.109-gallons per foot of depth.
 - 5) 96-inch Diameter: 0.190-gallons per foot of depth.
 13. Testing for tanks and wet wells is specified in Section 01 41 40.
- G. Testing specified in individual sections:
1. Section 03 30 00 – Cast-In-Place Concrete according to the requirements of Field Quality Control.

End.

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 References
- 1.3 Temporary Electricity
- 1.4 Temporary Lighting for Construction Purposes
- 1.5 Temporary Heating
- 1.6 Temporary Cooling
- 1.7 Temporary Ventilation
- 1.8 Communication Services
- 1.9 Temporary Water Service
- 1.10 Temporary Sanitary Facilities
- 1.11 Field Offices and Sheds
- 1.12 Vehicular Access
- 1.13 Parking
- 1.14 Progress Cleaning and Waste Removal
- 1.15 Traffic Regulation
- 1.16 Fire-Prevention Facilities
- 1.17 Barriers
- 1.18 Enclosures and Fencing
- 1.19 Security
- 1.20 Water Control
- 1.21 Dust Control
- 1.22 Noise Control
- 1.23 Pest and Rodent Control
- 1.24 Pollution Control
- 1.25 Removal of Utilities, Facilities, and Controls

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary cooling.
 - 5. Temporary ventilation.
 - 6. Communication services.
 - 7. Temporary water service.
 - 8. Temporary sanitary facilities
- B. Construction Facilities:
 - 1. Field offices and sheds.
 - 2. Vehicular access.
 - 3. Parking.

4. Progress cleaning and waste removal.
 5. Traffic regulation.
 6. Fire-prevention facilities.
- C. Temporary Controls:
1. Barriers.
 2. Enclosures and fencing.
 3. Security.
 4. Water control.
 5. Dust control.
 6. Noise control.
 7. Pest and rodent control.
 8. Pollution control.
- D. Removal of utilities, facilities, and controls.

1.2 REFERENCES

- A. ASTM International:
1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission 3. Loss of Building Partitions and Elements.
 3. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 TEMPORARY ELECTRICITY

- A. Provide and pay for power service required from utility source as needed for construction operation.
- B. Complement existing power service capacity and characteristics as required for construction operations.
- C. Provide power outlets with branch wiring and distribution boxes located as required for construction operations. Provide suitable, flexible power cords as required for portable construction tools and equipment.
- D. Permanent convenience receptacles shall not be used during construction.

1.4 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, lamps, and the like, for specified lighting levels.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be used during construction.

1.5 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of energy used.

- B. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress unless indicated otherwise in individual product Sections.

1.6 TEMPORARY COOLING

- A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of energy used.

1.7 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.8 COMMUNICATION SERVICES

- A. Telephone Service: Provide, maintain, and pay for telephone service to field office and Engineer's field office at time of Project mobilization and until completion of Work.
- B. Internet Service: Provide, maintain, and pay for broadband Internet service to field office and Engineer's field office at time of Project mobilization. Provide desktop computer with Microsoft operating system and appropriate office function software, modem, and printer.

1.9 TEMPORARY WATER SERVICE

- A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of water used.
- B. Provide temporary reduced pressure backflow preventer at point of connection.
- C. Extend branch piping with outlets located so that water is available by hoses with threaded connections. Provide temporary pipe insulation and heat tape to prevent freezing.

1.10 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization.
- B. At end of construction, return existing facilities used for construction operations to same or better condition as original condition.

1.11 FIELD OFFICES AND SHEDS

- A. Do not use permanent facilities for field offices or for storage.
- B. Construction: Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to foundations with steps and landings at entrance doors.
 - 1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures at completion of Work.
 - 2. Thermal Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
 - 3. Exterior Materials: Weather-resistant finished in colors acceptable to Engineer.

4. Interior Materials in Field Offices: Sheet-type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
 5. Lighting for Field Offices: 50 ft. at desktop height; exterior lighting at entrance doors.
 6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.
- C. Environmental Control:
1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
 2. Storage Spaces: Heating and ventilating as needed to maintain products according to Contract Documents; lighting for maintenance and inspection of products.
- D. Engineer and Owner Field Office:
1. Separate space for use of Engineer and Owner only, with separate entrance door with new lock and two keys.
 2. Area: Minimum 150 sq. ft.
 3. Windows: Minimum of three with a minimum total area of 10 percent of floor area, with operable sash and insect screens. Locate windows to provide views of construction area.
 4. Electrical Distribution Panel: Two circuits minimum, 110 volt, 60-Hz service.
 5. Minimum of four 110-volt duplex convenience outlets, one on each wall.
 6. Communication Services: As specified in this Section.
 7. Engineer and Owner Field Office Furnishings:
 - a. One desk 54 x 30 inches with three drawers.
 - b. One drafting table.
 - c. One metal, double-door storage cabinet under table.
 - d. Plan rack to hold working Drawings, Shop Drawings, and Record Documents.
 - e. One standard four-drawer letter size metal filing cabinet with locks and two keys for each lock.
 - f. Six linear ft. of metal bookshelves.
 - g. Two swivel armchairs.
 - h. Two straight chairs.
 - i. One drafting table stool.
 - j. One tack board 36 x 30 inches.
 - k. One wastebasket for each desk and table.
- E. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and inspection of products to suit requirements in Section 01 60 00 - Product Requirements.
- F. Preparation: Fill and grade Sites for temporary structures sloped for drainage away from buildings.
- G. Installation:
1. Install field office spaces ready for occupancy 15 days after date established by Notice to Proceed.
 2. Employee Residential Occupancy: Not allowed on Owner's property.
- H. Maintenance and Cleaning:
1. Weekly janitorial services for field offices; periodic cleaning and maintenance for sheds and storage areas.
 2. Maintain walks free of mud, water, snow, and the like.

- I. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same or better condition as original condition.

1.12 VEHICULAR ACCESS

- A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load-bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.
- D. Locate as indicated on Drawing or as approved by Engineer.
- E. Provide unimpeded access for emergency vehicles. Maintain 20 foot wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants and control valves free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets.
- H. Do not use existing on-Site roads for construction traffic.

1.13 PARKING

- A. Construct temporary gravel surface parking areas to accommodate construction personnel.
- B. Locate as indicated on Drawings or approved by Engineer.
- C. If Site space is not adequate, provide additional off-Site parking.
- D. Use of designated areas of existing on-Site streets and driveways used for construction traffic is not permitted. Tracked vehicles are not allowed on paved areas.
- E. Use of designated areas of existing parking facilities used by construction personnel is not permitted.
- F. Do not allow heavy vehicles or construction equipment in parking areas.
- G. Do not allow vehicle parking on existing pavement.
- H. Designate two parking spaces for Engineer and Owner.
- I. Permanent Pavements and Parking Facilities:
 - 1. Before Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
 - 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles are not allowed.
- J. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.

2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.
- K. Removal, Repair:
1. Remove temporary materials and construction when permanent paving is usable.
 2. Remove underground Work and compacted materials to depth of 2 feet; fill and grade Site as indicated.
 3. Repair existing and permanent facilities damaged by use, to original condition.
- L. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.14 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.
- C. Broom and vacuum clean interior areas before starting surface finishing and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from Site weekly and dispose of off-Site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.15 TRAFFIC REGULATION

- A. Signs, Signals, and Devices:
1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
 2. Traffic Control Signals: As approved by local jurisdictions.
 3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
 4. Flag Person Equipment: As required by authorities having jurisdiction.
- B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.
- C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.
- D. Haul Routes:
1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.
 2. Confine construction traffic to designated haul routes.
 3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.
- E. 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. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
 3. Relocate signs and signals as Work progresses, to maintain effective traffic control.
- F. Removal:
1. Remove equipment and devices when no longer required.
 2. Repair damage caused by installation.
 3. Remove post settings to depth of 2 feet.

1.16 FIRE-PREVENTION FACILITIES

- A. Prohibit smoking within buildings under construction and demolition. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
- B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
 1. Provide one fire extinguisher at each stairway on each floor of buildings under construction and demolition.
 2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.
 3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

1.17 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations and any demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.
- C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.
 1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
 2. Provide 6-foot barriers around drip line, with access for maintenance.
 3. Replace trees and plants damaged by construction operations.
- D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.
- E. Emergency Access:

At the end of each working day or at any time Contractor's personnel are not working in any portion of the project site, provide a clear, unobstructed path through the project site or through that portion of the project site suitable for access by police, ambulances, fire trucks, or any other emergency vehicles.

 1. Periodically during construction review with representatives of local emergency services the procedures being used and arrangements made to provide this required emergency vehicle access.

The Contractor shall notify the Central Dispatcher of the Fire Department and the Police

Department prior to the closing or cutting of any public thoroughfare.

F. Temporary Traffic Facilities:

1. When it is necessary for public or private vehicular traffic to pass through any portion of the project site, the Contractor shall, at his own expense, provide and maintain suitable and safe bridges, detours, temporary surfaces or other temporary installations expedient for the accommodation of public and private travel and shall give reasonable notice to owners of private drives before interfering with them; provided, however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the Owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at any designated point thereon, and for the duration of whatever period of time as may be agreed upon.
2. Whenever construction operation requires temporary surfacing to permit vehicular or pedestrian traffic, such temporary surfacing shall be as approved or directed by the Engineer and shall be installed by the Contractor at his expense.

G. Barricades and Lights:

1. All signing and barricades shall be provided and maintained by the Contractor.
2. All signs, barricades and drums used to control traffic shall be reflectorized. All signs, barricades, cones and drums shall be securely erected and maintained in good condition at all times.
3. All devices shall conform to the current manual on Uniform Traffic Control Devices as to size and color.
4. All barricades, signs, amber lights and other protective devices shall be installed as required by the current United States Department of Transportation and Federal Highway Administration Manual on Uniform Traffic Control Devices, Part IV, Traffic Control for Street and Highway Construction and Maintenance Operations.

1.18 ENCLOSURES AND FENCING

A. Construction: Contractor's option.

B. Exterior Enclosures:

1. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

C. Interior Enclosures:

1. Provide temporary partitions and ceilings as indicated on Drawings to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
2. Construction: Framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces.
 - a. Insulated.

1.19 SECURITY

A. Security Program:

1. Protect Work on existing premises from theft, vandalism, and unauthorized entry.
2. Initiate program in coordination with Owner's existing security system at Project

- 3. mobilization.
- 3. Maintain program throughout construction period until Owner occupancy.
- B. Entry Control:
 - 1. Restrict entrance of persons and vehicles to Project Site and existing facilities.
 - 2. Allow entrance only to authorized persons with proper identification.
 - 3. Maintain log of workers and visitors and make available to Owner on request.
 - 4. Control entrance of persons and vehicles related to Owner's operations.
- C. Restrictions:
 - 1. Do not allow cameras on Site or photographs taken except by written approval of Owner.
 - 2. Do no work on Saturdays or Sundays without prior approval of Owner.

1.20 WATER CONTROL

- A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.
- B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.

1.21 DUST CONTROL

- A. Execute Work by methods that minimize raising dust from construction operations.
- B. Provide positive means to prevent airborne dust from dispersing into atmosphere and into Owner-occupied areas.

1.22 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.23 PEST AND RODENT CONTROL

- A. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.24 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

1.25 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials before Final Application for Payment inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade Site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore existing and permanent 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.

SECTION 01 60 00

PRODUCT REQUIREMENTS

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Products
- 1.3 Product Delivery Requirements
- 1.4 Product Storage and Handling Requirements
- 1.5 Product Options

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

- 3.1 Maintenance or Storage

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- E. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product. This includes pumps, valves, controls, and other electrical or process equipment.
 - 1. Maintain temperature and humidity within ranges required by manufacturer's instructions.
 - 2. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
 - 1. Provide storage areas above anticipated high-water elevation.
 - 2. Provide substantial platforms, blocking, or skids to support fabricated products above ground.
 - 3. Protect products from soiling and staining.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

3.1 MAINTENANCE OF STORAGE

- A. Inspect stored products on schedule basis.
- B. Verify storage facilities comply with manufacturer's product storage requirements.
- C. Verify manufacturer required environmental conditions are maintained continually.
- D. Verify surfaces of products exposed to elements are not adversely affected and if weathering of finishes is acceptable under requirements of Contract Documents.

End.

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Responsibility of Contractor
- 1.3 Field Engineering
- 1.4 Closeout Procedures
- 1.5 Manufacturers Supervision, Inspection, Startup and Operation of Equipment
- 1.6 Starting of Systems
- 1.7 Demonstration and Instructions
- 1.8 Project Record Documents
- 1.9 Operation and Maintenance Data
- 1.10 Manual for Materials and Finishes
- 1.11 Manual for Equipment and Systems
- 1.12 Spare Parts and Maintenance Products
- 1.13 Product Warranties and Product Bonds
- 1.14 Maintenance Service

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

- 3.1 General
- 3.2 Examination
- 3.3 Preparation
- 3.4 Execution
- 3.5 Cutting and Patching
- 3.6 Protecting Installed Construction
- 3.7 Final Cleaning
- 3.8 Standards and Codes

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Responsibility of Contractor
- B. Field Engineering
- C. Closeout Procedures
- D. Starting of Systems
- E. Demonstration and Instructions
- F. Project Record Documents
- G. Operation and Maintenance Data
- H. Manual for Materials and Finishes
- I. Manual for Equipment and Systems

- J. Spare Parts and Maintenance Products
- K. Product Warranties and Product Bonds
- L. .Maintenance Service
- M. Examination
- N. Preparation
- O. Execution
- P. Cutting and Patching
- Q. Protecting Installed Construction
- R. Final Cleaning
- S. Standards and Codes

1.2 RESPONSIBILITY OF CONTRACTOR

- A. Protection of his Work.
- B. Protection of all property from injury or loss resulting from his operations.
- C. Replace or repair objects sustaining any such damage, injury or loss to satisfaction of Owner and Engineer.
- D. Cooperate with Owner, Engineer and representatives of utilities in locating underground utility lines and structures. Incorrect, inaccurate or inadequate information concerning location of utilities or structures shall not relieve Contractor of responsibility for damage thereto caused by his operation.
- E. Keep cleanup current with construction operations.
- F. Comply with all Federal, State of Iowa, Polk County, Bloomfield Township, laws and ordinances.

1.3 FIELD ENGINEERING

- A. Construction Staking: Contractor shall provide construction staking as follows:
 - 1. Contractor shall provide for staking needed to complete the Work.
 - 2. All detailed surveys and stakeouts shall be checked by the Contractor who shall assume responsibility for accuracy and correctness thereof.
- B. Locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is indicated on Drawings.
- D. Prior to beginning Work, verify and establish floor elevations of existing facilities to ensure that new Work will meet existing elevations in smooth and level alignment except where specifically detailed or indicated otherwise.

- E. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- F. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- G. Promptly report to Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- H. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

1.4 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
 - 1. Submit maintenance manuals, Project record documents, and other similar final record data in compliance with this Section.
 - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
 - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
 - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
 - 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
 - 6. Make final change-over of locks eliminating construction master-key system and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.
 - 7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
 - 8. Perform final cleaning according to this Section.
 - 9. Remove temporary facilities from site.
- B. Substantial Completion Inspection:
 - 1. When Contractor considers Work to be substantially complete, submit to Engineer and Owner:
 - a. Written certificate that Work, or designated portion, is substantially complete.
 - b. List of items to be completed or corrected (initial punch list).
 - 2. Within seven days after receipt of request for Substantial Completion, Engineer and Owner will set up a site inspection to determine whether Work or designated portion is substantially complete.
 - 3. Should Engineer or Owner determine that Work is not substantially complete:
 - a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
 - c. Engineer and Owner will reinspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's and Owner's inspection.

4. When Engineer and Owner finds that Work is substantially complete, Engineer will:
 - a. Prepare Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
 - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
 5. After Work is substantially complete, Contractor shall:
 - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.
 6. Owner will occupy all of building as specified in Section 01 10 00 – Summary.
- C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
1. When Contractor considers Work to be complete, submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.
 - d. Work is completed and ready for final inspection.
 2. Submittals: Submit following:
 - a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts and claims.
 - f. Contractor affidavit of release of liens.
 - g. Consent of surety to final payment.
 3. Perform final cleaning for Contractor-soiled areas according to this Section.
- D. Final Completion Inspection:
1. Within seven days after receipt of request for final inspection, Engineer and Owner set up a site inspection to determine whether Work or designated portion is complete.
 2. Should Engineer or Owner consider Work to be incomplete or defective:
 - a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
 - b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.
 - c. Engineer and Owner will reinspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's and Owner's inspection.

1.5 **STARTING OF SYSTEMS**

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Engineer and Owner seven days prior to startup of each item.
- C. Verify that 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 that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report according to Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.6 MANUFACTURERS SUPERVISION, INSPECTION, STARTUP AND OPERATION OF EQUIPMENT

- A. It is the intent of these specifications that all equipment shall be installed under the supervision of a competent representative of the Manufacturer. The minimum service of this type which will be required is:
 - 1. Inspect all components for proper alignment, proper noise levels, proper installation and satisfactory performance.
 - 2. Make pre-operation adjustments required to prepare the equipment for full operation.
 - 3. Operate the system, make needed adjustments.
 - 4. Train the Operator on use, adjustment calibration, programming and maintenance of the system.
 - 5. Training to include hands-on operation of equipment by staff to insure understanding of equipment details and ability for proper operation.
 - 6. Manufacturer shall furnish a report to the Engineer and Owner indicating:
 - a. If the equipment has been properly installed.
 - b. Any repairs, revisions or adjustment necessary for satisfactory installation.
 - c. Summary of tests conducted and the results.
 - d. Report to be signed by a responsible officer of the company
 - 7. Contractor is to video entire startup training session required by each equipment manufacturer for Major Equipment Items. Owner shall be given a digital copy of the complete session within one week of startup completion.
 - 8. Unless indicated differently, the minimum time to be spent by the Manufacturer's Representative shall be eight (8) hours.
- B. At least 60 days but not more than 90 days after the equipment is in operation, the Representative shall again visit the site. A minimum of one day shall be spent with the operator reviewing the equipment operation, including further instruction on maintenance and repairs.
- C. The cost of these services to insure an installation completely acceptable in all respects, including additional time required due to faulty equipment, improper installation or other circumstances which extend the startup and inspection shall be included in the contract price for the individual equipment items. Failure to provide adequate inspection and startup will be cause for nonpayment and non-acceptance of the work.
- D. The right is reserved by the Owner to require more than the minimum supervision and inspection service whenever, in the opinion of the Engineer, such additional service is required to insure satisfactory installation and operation. Separate payment will be made

for such additional Manufacturer's installation, inspection and startup services.

- E. This Section applies to all major equipment items listed in the Proposal. Other equipment and products may require manufacturer's services. Refer to the individual sections for additional requirements.

1.7 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance
- D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment or other designated location.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- F. Required instruction time for each item of equipment and system is specified in individual Specification Sections.

1.8 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Reviewed Shop Drawings, product data, and Samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
 7. Engineer Field Orders or written instructions.
 8. Field test records.
 9. Construction photographs.
 10. All associated permits.
 11. Certificates of inspection and approvals.
- 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 actual products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates used.
 3. Changes made by Addenda and modifications.

- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 2. Include locations of concealed elements of the Work.
 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 5. Identify and locate existing buried or concealed items encountered during Project.
 6. Measured depths of foundations in relation to datum.
 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 9. Field changes of dimension and detail.
 10. Details not on original Drawings.
- G. Submit marked-up paper copy documents to Engineer before Substantial Completion.
- H. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.
- I. Label each document "PROJECT RECORD" in neat, large printed letters.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Submit data bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable covers.
- C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 2. 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. Include the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.

- f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
- g. Safety precautions to be taken when operating and maintaining or working near equipment.
- 3. Part 3: Project documents and certificates, including the following:
 - a. Shop Drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Originals of warranties and bonds.

1.10 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
- B. For equipment or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes before Substantial Completion. Draft copy be reviewed and returned after Substantial Completion, with Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit three sets of revised final volumes within ten days after final inspection
- E. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.
- F. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom-manufactured products.
- G. 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.
- H. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- I. Additional Requirements: As specified in individual product Specification Sections.
- J. Include listing in table of contents for design data, with tabbed fly sheet and space for insertion of data.

1.11 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes before Substantial Completion. Draft copy will be reviewed and returned after Substantial Completion, with Engineer comments. Revise content of document sets as required prior to final submission.

- D. Submit three sets of revised final volumes within ten days after final inspection.
- E. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.
- F. 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.
- G. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- H. Include color-coded wiring diagrams as installed.
- I. 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.
- J. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- K. Include servicing and lubrication schedule and list of lubricants required.
- L. Include manufacturer's printed operation and maintenance instructions.
- M. Include sequence of operation by controls manufacturer.
- N. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- O. Include control diagrams by controls manufacturer as installed.
- P. Include Contractor's coordination drawings with color-coded piping diagrams as installed.
- Q. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- R. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- S. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.
- T. Additional Requirements: As specified in individual product Specification Sections.
- U. Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

- B. Deliver to place in location as directed by Owner; obtain receipt prior to final payment.

1.13 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten 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 and assemble in three D side ring binder with durable cover.
- F. Submit prior to final Application for Payment.
- G. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 - 2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.14 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in Specification Sections for Two (2) years from date of Substantial Completion, unless otherwise indicated in the Specification Section.
- 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

3.1 GENERAL

- A. Contractor shall carefully preserve all benchmarks, reference points, and stakes.
- B. In case of willful or careless destruction of those benchmarks, points or stake, contractor shall be charged with the resulting additional expense for re-staking. Contractor shall be responsible for any mistakes or loss of time caused by their loss or disturbance.

- C. All detailed surveys and staking, including those described above shall be checked by Contractor who shall assume full responsibility for accuracy and correctness thereof.
- D. Safety Regulations:
This contract is subject to the provisions of the Williams-Steiger Occupational Safety and Health Act of 1970.

3.2 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 support or 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 with correct characteristics and in correct locations.

3.3 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- 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.

3.4 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Architect/Engineer for final decision.
- E. Allow for expansion of materials and building movement.

- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
 - 1. Refer questionable mounting heights choices to Architect/Engineer for final decision.
 - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.
- J. Defective Equipment:
 - 1. Owner retains right to operate equipment until defects are corrected and guarantees satisfied.
 - 2. Owner reserves the right to operate rejected equipment or other work until replaced, without cost for depreciation, use or wear.
 - 3. Remove equipment or other work from operation for examination, adjustment or change at times approved by Engineer.

3.5 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 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. Request shall include:
 - 1. Identification of project.
 - 2. Description of affected Work.
 - 3. Necessity for cutting, alteration or excavation.
 - 4. Effect on work of any separate contractor, or on structural or weather proof integrity of project.
 - 5. Description of proposed work.
 - a. Scope of cutting, patching, alteration, or excavation.
 - b. Trades who will execute the Work.
 - c. Production proposed to be used.
 - d. Extent of refinishing to be done.
- D. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and nonconforming Work.
 - 4. Remove samples of installed Work for testing.

- 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- E. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- F. Cut masonry and concrete materials using masonry saw or core drill.
- G. Restore Work with new products according to requirements of Contract Documents.
- H. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- I. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.6 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. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- D. Prohibit traffic from landscaped areas.

3.7 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
 - 1. Employ experienced personnel or professional cleaning firm.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; and vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.

- G. Remove waste and surplus materials, rubbish, and construction facilities from Site.
- H. Remove and dispose of any hazardous material remaining on site in accordance with the Iowa Administrative Code.

3.8 STANDARDS AND CODES

- A. Do work in accordance with best present-day installation and construction practices.
- B. Conform to and test materials in accordance with applicable sections of latest revisions or tentative revisions of following codes and standards unless specifically noted to contrary:
 1. Air Moving and Conditioning Association (AMCA).
 2. American Association of State Highway and Transportation Officials (AASHTO).
 3. American Concrete Institute (ACI).
 4. American Gas Association (AGA).
 5. American Gear Manufacturers Association (AGMA).
 6. American Institute of Steel Construction (AISC).
 7. American National Standards Institute (ANSI).
 8. American Plywood Association (APA).
 9. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 10. American Society for Testing and Materials (ASTM).
 11. American Standards Association (ASA).
 12. American Water Works Association (AWWA).
 13. American Welding Society (AWS).
 14. Anti-friction Bearing Manufacturer's Association (AFBMA).
 15. Federal Specifications (FS).
 16. Hydraulic Institute (HI).
 17. Institute of Electrical and Electronic Engineers (IEEE).
 18. Insulated Power Cable Engineers Association (IPCEA).
 19. Iowa Department of Transportation (IDOT); latest edition of Standard Specifications and addenda.
 20. Iowa Occupational Safety and Health Act of 1972 (Chapter 83, Code of Iowa 1983) (IOSHA).
 21. Manual of Accident Prevention in Construction by Associated General Contractors of America, Inc. (AGC).
 22. Mining Enforcement and Safety Administration (MESA).
 23. National Association of Architectural Metal Manufacturers (NAAMM).
 24. National Electrical Manufacturers Association (NEMA).
 25. National Electrical Safety Code (NESC).
 26. National Fire Protection Association, Inc. (NFPA).
 27. National Fire Protection Associations National Electrical Code (NEC).
 28. National Institute for Occupational Safety and Health (NIOSH).
 29. National Lumber Manufacturer's Association (NLMA).
 30. National Safety Council (NSC).
 31. Occupational Safety and Health Act of 1970 (Public Law 91-596) (OSHA).
 32. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
 33. Steel Structures Painting Council (SSPC).
 34. Underwriters' Laboratories, Inc. (UL).
 35. West Coast Lumber Inspection Bureau (WCLB).
 36. Standards and Codes of the State of Iowa and applicable local standards and codes of the Owner.
 37. Other standards and codes which may be applicable to acceptable standards of the industry for equipment, materials and installation under the contract

End.

DIVISION 02 – EXISTING CONDITIONS

SECTION 02 41 00

DEMOLITION

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PART 1 – GENERAL

- 1.1 Summary.
- 1.2 Submittals.
- 1.3 Closeout Submittals.
- 1.4 Quality Assurance.
- 1.5 Sequencing.
- 1.6 Scheduling.
- 1.7 Project Conditions.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

- 3.1 Examination.
- 3.2 Preparation.
- 3.3 Salvage Requirements.
- 3.4 Demolition Requirements.
- 3.5 Demolition.
- 3.6 Abandonment.
- 3.7 Disposal.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated structures.
 - 2. Demolishing designated foundations.
 - 3. Demolishing designated slabs-on-grade.
 - 4. Disconnecting and capping designated utilities.
 - 5. Removing designated items for reuse and Owner's retention.
 - 6. Protecting items designated to remain.
 - 7. Removing demolished materials.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of barricades, fences, and temporary work.
- C. Design data: Submit calculations for bracing, shoring, and underpinning signed and sealed by professional engineer.
- D. Existing building documentation: Submit the following for existing buildings indicated to remain:
 - 1. Survey indicating position and elevation of exterior building features.
 - 2. Photographic survey indicating conditions before, during, and after demolition work.

- E. Submit copy of permits required by regulatory agencies for demolition and sidewalk and street closings.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 QUALITY ASSURANCE

- A. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control, runoff control, and disposal.
- B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.
- D. Perform Work in accordance with the Bloomfield Township, Iowa municipal code.
- E. Conform to regulations of utility companies and Regulatory Agencies.

1.5 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.

1.6 SCHEDULING

- A. Section 01 32 16 - Construction Progress Schedule: Requirements for scheduling.
- B. Schedule:
 - 1. Perform demolition and removal work so as not to interfere with Owner's operations.
 - 2. Coordinate demolition and removal work so new construction can proceed without undue delay.
 - 3. Refer to Drawings for Demolition.

1.7 PROJECT CONDITIONS

- A. Prior to demolition of structures, accomplish following:
 - 1. Owner release of such structure.
 - 2. Electrical and mechanical services rerouted or shut off outside area of demolition.
 - 3. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.
 - 4. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore facilities to pre-demolition condition at no additional cost to Owner. Surveys to be conducted in presence of Engineer.

- B. Protection:
 - 1. Do not close or obstruct streets, walks and other public facilities occupied and used by Owner and public without prior written permission from Owner and other authorities having jurisdiction.
 - 2. Structural stability of structures adjacent to or affected by work of this Contract shall be responsibility of Contractor.
 - 3. Maintain in service and protect from damage existing facilities, utilities, and equipment indicated to remain or adjacent to work areas.
- C. Utilities:
 - 1. Notify utilities prior to razing operations to permit them to disconnect, remove and/or relocate any equipment serving existing facilities.
- D. Salvageable Materials:
 - 1. Owner shall have first right to salvageable material.
 - 2. Salvaged material and equipment to be retained by Owner shall be delivered to the Owner.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine existing buildings indicated to be demolished before demolition.
- B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
- C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings indicated to remain.
 - 1. Identify measures required to protect buildings from damage.
 - 2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.
- D. Verify hazardous material abatement is complete before beginning demolition.

3.2 PREPARATION

- A. Provide, erect, and maintain temporary barriers and security devices.
- B. Protect existing landscaping materials, appurtenances, structures and utilities which are not to be demolished.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
- D. Mark location of utilities.

3.3 SALVAGE REQUIREMENTS

- A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.

- B. Tag components and equipment Owner designates for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged.
- E. Disassemble as required to permit removal from building.
- F. Package small and loose parts to avoid loss.
- G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.4 DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures and utilities.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify Engineer. Do not resume operations until directed.
- C. Conduct operations with minimum interference to public or private accesses. Maintain protected egress and access at all times.
- D. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.
- E. Keep work sprinkled with water to minimize dust. Provide hoses and water connections for this purpose.

3.5 DEMOLITION

- A. Disconnect and cap and identify designated utilities within demolition areas.
- B. Plug or cap utility drains and other piping in accordance with specified abandonment procedures. Provide thrust blocks on pressure lines.
- C. Remove existing concrete, steel and masonry to extent indicated on drawings. Provide smooth, straight joint or cut line. Make cuts parallel with walls and/or floors.
- D. Concrete structures to be removed to 10-feet below finished grade. Floors of concrete structures to be removed if less than 10-feet below finished grade. Floors of concrete structures greater than 10-feet below finished grade are to be crushed and left in place.
- E. Remove utilities and equipment to elevations and locations shown on drawings and plug and seal permanently with steel cap, concrete plug or other approved method in accordance with specified abandonment procedures.
- F. Provide temporary shoring and bracing to transfer loads of existing construction to remain from construction being removed.

- G. Remove materials to be salvaged, re-installed or retained in manner to prevent damage. Store and protect.
- H. Do not burn or bury materials on site. Leave site in clean condition.
- I. Do not use blasting method for demolition.
- J. Provide drainage for structure demolished and buried. Cut holes in floor and walls at spacing of 20-feet on center
- K. Fill below grade abandoned structures with compacted Type 'C' Fill material.

3.6 ABANDONMENT

- A. Abandon utilities and underground piping within limits noted.
- B. Abandon disconnected utilities and underground piping within influence zone of proposed underground piping and proposed structures.
- C. Provide compatible cap for pressurized type piping. Provide thrust blocks for caps unless piping has fully restrained joints.
- D. Provide concrete plugs for gravity type piping. Plug shall be concrete in accordance with Section 03 30 00. Plug shall be at least 2-feet thick.

3.7 DISPOSAL

- A. Separate all wood materials, plaster, lath, metal and trash from brick and concrete rubble.
- B. Haul all wood materials, plaster, lath, metal and trash to a landfill approved to receive material of this nature. Contractor responsible for all landfill costs.
- C. Concrete and brick shall be disposed of as follows:
 - 1. Cut exposed rebar from all concrete rubble.
 - 2. Haul above listed materials to contractor obtained site. Contractor to pay all disposal costs.
 - 3. Legally dispose of materials at a location off site.
- D. All disposals shall be in accordance with Federal, State and local laws, ordinances and rules of Bloomfield Township and Polk County, Iowa.

End.

SECTION 02 41 16

STRUCTURE DEMOLITION

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PART 1 - GENERAL

- 1.1 Summary.
- 1.2 Submittals.
- 1.3 Closeout Submittals.
- 1.4 Quality Assurance.
- 1.5 Sequencing.
- 1.6 Scheduling.
- 1.7 Project Conditions.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

- 3.1 Examination.
- 3.2 Preparation.
- 3.3 Demolition Requirements.
- 3.4 Demolition.
- 3.5 Abandonment.
- 3.6 Disposal.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated structures.
 - 2. Demolishing designated foundations.
 - 3. Demolishing designated slabs-on-grade.
 - 4. Disconnecting and capping designated utilities.
 - 5. Removing designated items for reuse and Owner's retention.
 - 6. Protecting items designated to remain.
 - 7. Removing demolished materials.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of barricades, fences, and temporary work.
- C. Design data: Submit calculations for bracing, shoring, and underpinning signed and sealed by professional engineer.
- D. Existing building documentation: Submit the following for existing buildings indicated to remain:
 - 1. Survey indicating position and elevation of exterior building features.

2. Photographic survey indicating conditions before, during, and after demolition work.
- E. Submit copy of permits required by regulatory agencies for demolition and sidewalk and street closings.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 QUALITY ASSURANCE

- A. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control, runoff control, and disposal.
- B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.
- D. Perform Work in accordance with the Bloomfield Township municipal code.
- E. Conform to regulations of utility companies and Regulatory Agencies.

1.5 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.

1.6 SCHEDULING

- A. Section 01 32 16 - Construction Progress Schedule: Requirements for scheduling.
- B. Schedule:
 1. Perform demolition and removal work so as not to interfere with Owner's operations.
 2. Coordinate demolition and removal work so new construction can proceed without undue delay.
 3. Refer to Drawings for Demolition.

1.7 PROJECT CONDITIONS

- A. Prior to demolition of structures, accomplish following:
 1. Owner release of such structure.
 2. Electrical and mechanical services rerouted or shut off outside area of demolition.
 3. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.

4. Survey and record the condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore facilities to pre-demolition condition at no additional cost to Owner. Surveys to be conducted in presence of Engineer.
- B. Protection:
1. Do not close or obstruct streets, walks and other public facilities occupied and used by Owner and public without prior written permission from Owner and other authorities having jurisdiction.
 2. Structural stability of structures adjacent to or affected by work of this Contract shall be responsibility of Contractor.
 3. Maintain in service and protect from damage existing facilities, utilities, and equipment indicated to remain or adjacent to work areas.
- C. Utilities:
1. Notify utilities prior to razing operations to permit them to disconnect, remove and/or relocate any equipment serving existing facilities.
- D. Salvageable Materials:
1. Owner shall have first right to salvageable material.
 2. Salvaged material and equipment to be retained by Owner shall be delivered to the Owner.

PART 2 – PRODUCTS –Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing buildings indicated to be demolished before demolition.
- B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
- C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings indicated to remain.
 1. Identify measures required to protect buildings from damage.
 2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.
- D. Verify hazardous material abatement is complete before beginning demolition.

3.2 PREPARATION

- A. Provide, erect, and maintain temporary barriers and security devices.
- B. Protect existing landscaping materials, appurtenances, structures and utilities which are not to be demolished.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
- D. Mark location of utilities.

3.3 DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures and utilities.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify Engineer. Do not resume operations until directed.
- C. Conduct operations with minimum interference to public or private accesses. Maintain protected egress and access at all times.
- D. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.
- E. Keep work sprinkled with water to minimize dust. Provide hoses and water connections for this purpose.

3.4 DEMOLITION

- A. Disconnect and cap and identify designated utilities within demolition areas.
- B. Plug or cap utility drains and other piping in accordance with specified abandonment procedures. Provide thrust blocks on pressure lines.
- C. Remove existing concrete, steel and masonry to extent indicated on drawings. Provide smooth, straight joint or cut line. Make cuts parallel with walls and/or floors.
- D. Concrete structures to be removed to 10-feet below finished grade. Floors of concrete structures to be removed if less than 10-feet below finished grade. Floors of concrete structures greater than 10-feet below finished grade are to be crushed and left in place.
- E. Remove utilities and equipment to elevations and locations shown on drawings and plug and seal permanently with steel cap, concrete plug or other approved method in accordance with specified abandonment procedures.
- F. Provide temporary shoring and bracing to transfer loads of existing construction to remain from construction being removed.
- G. Remove materials to be salvaged, re-installed or retained in manner to prevent damage. Store and protect.
- H. Do not burn or bury materials on site. Leave site in clean condition.
- I. Do not use blasting method for demolition.
- J. Provide drainage for structure demolished and buried. Cut holes in floor and walls at spacing of 20-feet on center
- K. Fill below grade abandoned structures with compacted Type 'C' Fill material.

3.5 ABANDONMENT

- A. Abandon utilities and underground piping within limits noted.

- B. Abandon disconnected utilities and underground piping within influence zone of proposed underground piping and proposed structures.
- C. Provide compatible cap for pressurized type piping. Provide thrust blocks for caps unless piping has fully restrained joints.
- D. Provide concrete plugs for gravity type piping. Plug shall be concrete in accordance with Section 03 30 00. Plug shall be at least 2-feet thick.

3.6 DISPOSAL

- A. Separate all wood materials, plaster, lath, metal and trash from brick and concrete rubble.
- B. Haul all wood materials, plaster, lath, metal and trash to a landfill approved to receive material of this nature. Contractor responsible for all landfill costs.
- C. Concrete and brick shall be disposed of as follows:
 - 1. Cut exposed rebar from all concrete rubble.
 - 2. Haul above listed materials to contractor obtained site. Contractor to pay all disposal costs.
 - 3. Legally dispose of materials at a location off site.
- D. All disposals shall be in accordance with Federal, State and local laws, ordinances and rules of Bloomfield Township and Polk County, Iowa.

END.

DIVISION 03 – CONCRETE

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

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- 1.5 Quality Assurance
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- 2.2 Pre-Fabricated Forms
- 2.3 Formwork Accessories

PART 3 – EXECUTION

- 3.1 Examination
- 3.2 Installation
- 3.3 Application – Form Release Agent
- 3.4 Installation – Inserts, Embedded Parts, and Openings
- 3.5 Form Cleaning
- 3.6 Form Removal
- 3.7 Erection Tolerances
- 3.8 Field Quality Control

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Architectural form liners.
 - 4. Form accessories.
 - 5. Form stripping.
- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 03 20 00 – Concrete Reinforcing.
 - 3. Section 03 30 00 – Cast-In-Place Concrete.
 - 4. Section 04 20 00 – Unit Masonry: Product requirements for masonry accessories for placement by this Section.
 - 5. Section 05 50 00 – Metal Fabrications: Product requirements for metal fabrications for placement by this Section.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

2. ACI 301 - Specifications for Structural Concrete.
 3. ACI 318 - Building Code Requirements for Structural Concrete.
 4. ACI 347 - Guide to Formwork for Concrete.
 5. ACI 350 – Environmental Engineering Concrete Structures
- B. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. American Society of Mechanical Engineers:
1. ASME A17.1 - Safety Code for Elevators and Escalators.
- E. ASTM International:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 2. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

- A. Design, erect, support, brace, and maintain formwork so it will safely support vertical and lateral loads applied, until such loads can be supported by the concrete structure.
- B. Carry vertical and lateral loads to ground by formwork system and in-place construction which has attained adequate strength.
- C. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.
- D. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated of formwork, concrete mix, and height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
- E. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
- F. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
- G. Support form facing materials by structural members spaced sufficiently close to prevent objectionable deflection.
- H. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.
- I. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

- J. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Submit formwork, shoring, and reshoring shop drawings.
 - 2. Indicate the following:
 - a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - b. Means of leakage prevention for concrete exposed to view in finished construction.
 - c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
 - d. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
 - e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
 - f. Procedure and schedule for removal of shores and installation and removal of reshores.
- C. Within 30-calendar days after Award of the Contract, submit manufacturer's data and installation instruction for proprietary materials including form coatings, ties and accessories, and manufacturer's form system (if used).
- D. Product Data: Submit data on void form materials and installation requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318 and ACI 350.
- B. For wood products furnished for work of this Section, comply with AF&PA.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Products storage and handling requirements.
- B. Deliver void forms and installation instructions in manufacturer's packaging.
- C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.
- C. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

PART 2 – PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Plywood: Douglas Fir species; exterior grade; sound undamaged sheets with clean, true edges.
- B. Lumber forms:
 - 1. Application: Use for edge forms and unexposed finish concrete.
 - 2. Boards: 6-inches or 8-inches in width, ship lapped or tongue and groove, “Standard” Grade Douglas Fir, conforming to WCLIB Standard Grading Rules for West Coast Lumber. Surface boards on four sides.

2.2 PRE-FABRICATED FORMS

- A. Preformed steel forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass fiber fabric reinforced plastic forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Pan Type: Steel or Glass fiber of size and profile required.
- D. Tubular column type: Round, spirally wound laminated fiber, wood or glass fiber material, surface treated with release agent, non-reusable.
- E. Steel forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.
- F. Form liners: Smooth, durable, grain less and non-staining hardboard, unless otherwise indicated on Drawings.
- G. Framing, studding and bracing: Stud or No. 3 structural light framing grade.

2.3 FORMWORK ACCESSORIES

- A. Form ties: Removable or Snap-off type, steel, adjustable length, cone type, with waterproofing washer, free of defects capable of leaving holes larger than 1 inch in concrete surface.
 - 1. For locations exposed to sewage or fluids: Use snap type plastic cone with water seal. Minimum 1-1/2-inch break back and maximum 1-inch cone diameter.
 - 2. Do not use wire ties where surface on either side will be exposed to moisture or chemical attack.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1-inch of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form anchors and hangers:
 - 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
 - 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 - 3. Penetration of structural steel members is not permitted.

- D. Form release agent: Colorless mineral oil that will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- E. Corners: Chamfer, rigid plastic or wood strip, 3/4-inch by 3/4-inch or as shown on drawings.
- F. Vapor retarder: Where indicated on Drawings, 8 mil thick polyethylene sheet.
- G. Bituminous joint filler: ASTM D1751.
- H. Nails, spikes, lag bolts, through bolts, anchorages: Size, strength and character to maintain formwork in place while placing concrete.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 INSTALLATION

- A. Earth forms:
 - 1. Earth forms are not permitted.
- B. Formwork - General:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 5. Complete wedging and bracing before placing concrete.
- C. Forms for smooth finish concrete:
 - 1. Use steel, plywood or lined board forms.
 - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 - 4. Use full size sheets of form lines and plywood wherever possible.
 - 5. Tape joints to prevent protrusions in concrete.
 - 6. Use care in forming and stripping wood forms to protect corners and edges.
 - 7. Level and continue horizontal joints.
 - 8. Keep wood forms wet until stripped.

- D. Architectural form liners:
 - 1. Erect architectural side of formwork first.
 - 2. Attach form liner to forms before installing form ties.
 - 3. Install form liner squares, with joints and pattern aligned.
 - 4. Seal form liner joints to prevent grout leaks.
 - 5. Dress joints and edges to match form liner pattern and texture.
- E. Forms for surfaces to receive membrane waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.
- F. Framing, studding and bracing:
 - 1. Space studs at 16-inches on center maximum for boards and 12-inches on center maximum for plywood.
 - 2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Construct beam soffits of material minimum of 2-inches thick.
 - 4. Distribute bracing loads over base area on which bracing is erected.
 - 5. When placed on ground, protect against undermining, settlement or accidental impact.
- G. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- H. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- I. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.
- J. Install chamfer strips on external corners of beams, joists, and columns.
- K. Install void forms in accordance with manufacturer's recommendations.
- L. Do not reuse wood formwork. Do not patch formwork.
- M. Forms for exposed concrete:
 - 1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
 - 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
 - 3. Use extra studs, walers, and bracing to prevent objectionable bowing of forms strips of form material that will produce bow.
 - 4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
- N. Corner treatment: Unless shown otherwise, form chambers with $\frac{3}{4}$ -inch by $\frac{3}{4}$ -inch strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
- O. Control joints: Locate as directed by Engineer or as indicated on the Drawings.

3.3 APPLICATION – FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and coating of forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION – INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- H. Form ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 1-inch away from finished surface of concrete.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- J. Construction joints:
 - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 - 4. Arrange joints in continuous line straight, true and sharp.

- K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete.
 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- L. Openings for items passing through concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
 2. Coordinate work to avoid cutting and patching of concrete after placement.
 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
 2. Slope slabs to drain where required or as shown on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.
- N. Screenshot supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
 2. Staking through membrane is not permitted.
- O. Cleanouts and access panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Formwork not supporting the weight of concrete and construction live loads, such as sides of beams, walls, columns, and similar parts of the work, shall remain in place until concrete has reached 75 percent of its specified 28-day strength.

- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed until concrete has attained design minimum 28-day compressive strength. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of the concrete location or members, as specified in other sections.
- C. Form-facing material may be removed four days after placement, only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.
- D. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable. Apply new form-coating compound material to concrete contact surfaces as specified for new formwork. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.8 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.
- C. Schedule concrete placement to permit formwork inspection before placing concrete.

End.

SECTION 03 20 00

CONCRETE REINFORCING

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PART 1 – GENERAL

- 1.1 Summary
- 1.2 References
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- 2.1 Reinforcement
- 2.2 Accessory Materials
- 2.3 Fabrication

PART 3 –EXECUTION

- 3.1 Placement
- 3.2 Erection Tolerances

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars.
 - 2. Welded wire fabric.
 - 3. Reinforcement accessories.

- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 03 10 00 - Concrete Forming and Accessories.
 - 3. Section 03 30 00 - Cast-In-Place Concrete.
 - 4. Section 03 35 00 - Concrete Finishing: Reinforcement for concrete floor toppings.
 - 5. Section 03 45 00 - Precast Architectural Concrete: Reinforcement for precast concrete panels.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
 - 3. ACI 530.1 - Specifications for Masonry Structures.
 - 4. ACI SP-66 - ACI Detailing Manual.

- B. ASTM International:
 - 1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 - 3. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

4. ASTM A496/A496M - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 5. ASTM A497/A497M - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 7. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
 8. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 9. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 10. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 11. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 12. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 13. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
- C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
 2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318.
- B. Prepare shop drawings in accordance with ACI SP-66.

1.5 QUALIFICATIONS

- A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 – PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing steel: ASTM A615 60 ksi yield grade, deformed billet bars.

2.2 ACCESSORY MATERIALS

- A. Tie wire: Minimum 16 gage annealed iron wire.
- B. Chairs, bolsters, bar supports, spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.
- C. Special chairs, bolsters, bar supports, spacers adjacent to weather exposed concrete surfaces: Stainless steel type; size and shape to meet Project conditions.

2.3 FABRICATION

- A. Fabricate concrete reinforcement in accordance with ACI 318.
- B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with ACI 318.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form ties and stirrups from the following:
 - 1. For bars No. 10 and Smaller: No. 3 deformed bars.
 - 2. For bars No. 11 and Larger: No. 4 deformed bars.
- F. Under no circumstances will welding of any reinforcing be allowed.
- G. Locate reinforcement splices not indicated on Drawings, at point of minimum stress.
- H. Hooks: Conform to requirements of Paragraph 7.1, ACI 318-77.
- I. Where column bars are offset or dowels used for column splices, provide ½-inch clearance between bars or dowels and vertical bars of next lift.
- J. Locate reinforcing splices not indicated on Drawings at point of minimum stress. Review location of splices with Engineer.
- K. Lap splices on #14 and larger bar or dowels are not permitted.

PART 3 – EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance:
 - 1. Do not weld crossing bars for assembly unless permitted by Engineer.
- B. Do not displace or damage vapor retarder.

- C. Accommodate placement of formed openings.
- D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318:
 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- E. Maintain concrete cover around reinforcement in accordance with ACI 318, as indicated on the drawings or as follows:

Reinforcement Location		Minimum Concrete Cover
Footings and Concrete Formed Against Earth		3-inches
Concrete exposed to earth or weather	No. 6 bars and larger	2-inches
	No. 5 bars and smaller	1-1/2-inches
Supported Slabs, Walls, and Joists	No. 14 bars and larger	1-1/2-inches
	No. 11 bars and smaller	3/4-inches
Beams and Columns		1-1/2-inches
Shell and Folded Plate Members	No. 6 bars and larger	3/4-inches
	No. 5 bars and smaller	1/2-inches

- J. Bars:
 1. Reinforce footings as shown on Drawings. Where reinforcing is not shown, minimum reinforcing shall be as follows for each wall thickness:
 - 6" wall - #4@18-inches, one layer
 - 8" wall - #4@18-inches, one layer
 - 10" wall - #4@18-inches, each face
 - 12" wall - #5@18-inches, each face
 - 24" wall - #7@16-inches, each face
 - 30" wall - #7@12-inches, each face
 2. Reinforce top of stem wall under door and other openings with two #5 bars, minimum; 4-feet longer than opening.
 3. Reinforce curbs as shown on Drawings. Where reinforcing is not shown, place one #5 bar top and bottom.
 4. At wall or floor openings, if reinforcing is not shown, include two #5 bars, each face, on all sides, 4-feet longer than opening dimension. Also add two #5 bars, each face, diagonally at each corner.
- K. Reinforce concrete sidewalks with mesh, 4 x 4 WWF 2.1 x 2.1.
- L. Reinforce concrete driveways (6-inch thickness) subjected to vehicular traffic with #4 bars at 12-inches on-center each way.
- M. Lap splices shall be in accordance with Chapter 12 of ACI 318-89. All reinforcing shall be lap spliced or doweled as shown on Drawings.
- N. Reinforcing embedded lengths shall be in accordance with ACI.
- O. Drilled dowel placement and depth shall be as indicated on the Drawings. EOR must be contacted for drilled dowel placement and depth if not shown on the drawings. Epoxy manufacturer shall be HILTI Corporation; or equivalent.

- P. Other:
1. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
 2. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
 3. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16-gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 4. Bars are to be tied at all intersections except where spacing is less than 1-foot in each direction, in which case alternate intersections are to be tied.
 5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least 1 full mesh.
 6. Provide sufficient numbers of supports and of strengths to carry reinforcement. Do not place reinforcing bars more than 2-inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
 7. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wrapped tie wire around bars.

3.2 **ERECTION TOLERANCES**

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8-inch	minus 3/8-inch
Less than 8 inches	plus or minus 1/2-inch	minus 1/2-inch

- C. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

End.

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

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- 3.9 Patching
- 3.10 Joint Fillers
- 3.11 Protection of Concrete Construction
- 3.12 Defective Concrete

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
 - 1. Shear walls.
 - 2. Supported slabs.
 - 3. Interior and exterior slabs on grade.
 - 4. Equipment pads.
 - 5. Footings and grade beams.
 - 6. Interior and exterior building and tankage slabs, walls and roofs.

- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 03 10 00 - Concrete Forming and Accessories.
 - 3. Section 03 20 00 - Concrete Reinforcing.
 - 4. Section 03 35 00 - Concrete Finishing.
 - 5. Section 07 90 00 - Joint Protection.

- C. Control, expansion, and contraction joint devices associated with concrete work including joint sealants.
- D. Work shall not be performed directly upon newly constructed concrete floor slabs:
 1. All newly poured and cured floor slabs shall be covered with heavy cloth or canvas or plastic coated tarpaulins for the duration of the construction period.
 2. Remove for periodic cleaning and replace before continuing construction Work.
 3. Remove and dispose of just prior to final inspection.
 4. No vehicles of any type shall be operated directly upon newly poured and cured floor slabs.
 5. No materials placed upon or stored directly on newly poured and cured floor slabs.
- E. Utilize all efforts necessary to protect surface of newly poured floor systems during the remainder of the construction period.

1.2 **REFERENCES**

- A. American Concrete Institute:
 1. ACI 211.1 – Recommended Practices for Selecting Proportions for Normal and Heavyweight Concrete, Current Edition.
 2. ACI 301 - Specifications for Structural Concrete.
 3. ACI 302 – Guide for Concrete Floor and Slab Construction.
 4. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete, Current Edition.
 5. ACI 305 - Hot Weather Concreting.
 6. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 7. ACI 308.1 - Standard Specification for Curing Concrete.
 8. ACI 318 - Building Code Requirements for Structural Concrete.
 9. ACI 350 – Environmental Engineering Concrete Structures.
- B. ASTM International:
 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 3. ASTM C33 - Standard Specification for Concrete Aggregates.
 4. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 5. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
 8. ASTM C150 - Standard Specification for Portland Cement.
 9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 10. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
 14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
 15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.

16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
17. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on joint devices, attachment accessories, and admixtures.
- C. Design data:
 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
 2. Identify mix ingredients and proportions, including admixtures.
- D. Manufacturer's installation instructions: Submit installation procedures and interface required with adjacent Work.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Fire rated Wall, Floor, or Roof construction: Rating as indicated on Drawings.
 - 1. Tested rating: Determined in accordance with ASTM E119.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7-days.

1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.
- C. Coordinate Work building concrete tankage for water processes with ACI-350, Code Requirements for Environmental Engineering Structures.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal except as otherwise noted on Drawings or approved by Engineer. Type III and Type V Cement may be specified as specified.
- B. Fine aggregate:
 - 1. Meet requirements of ASTM C33-71a, except where more rigid requirements are included.
 - 2. Gradation within requirements of ASTM C33, Sections 4, 5, 6 and 7. Sieve analysis of aggregate must accompany mix design when submitted to Engineer for review.
 - 3. Natural sand:
 - a. Clean, hard, strong, durable, uncoated grains.
 - b. Coal and lignite: 0.25 percent maximum.
 - c. Prove acceptability of aggregate by laboratory test conducted and certified

by laboratory acceptable to Engineer on sample taken in accordance with ASTM C75.

- C. Course aggregate:
 - 1. Meet requirements of ASTM C33-71a, Sections 8, 9 and 10, except where more rigid requirements are included.
 - 2. Clean, hard, strong, durable, uncoated grains.
 - 3. Gradation within requirements of ASTM C33, Table II:
#57, 1" to No. 4; for footings and plain concrete.
#57, 1" to No. 4; for slabs on grade and reinforced walls.
#57, 1" to No. 4; for slabs, beams, fillet and fill concrete.
 - 4. Limitation of deleterious substances:
 - a. Clay lumps and friable particles: Maximum 1.0 percent.
 - b. Soft particles: Maximum 2.0 percent.
 - c. Coal and Lignite: Maximum 0.25 percent.
 - 5. Crushed limestone: Meet IDOT Specifications 4115.03 for quality and 4115.04 for durability; prove acceptability by submission of certified laboratory test report.
- D. Water: ACI 318; potable, without deleterious amounts of oil, acid, alkali, chlorides and sulfates, other common salts, organic matter or other deleterious substances.

2.2 **ADMIXTURES**

- A. Air entrainment: ASTM C260.
 - 1. All concrete exposed to weather and freeze-thaw cycles shall be air-entrained, unless otherwise specified.
 - 2. Air entrainment shall be as indicated on the concrete schedule.
- B. Fly Ash: ASTM C618 Class C.
 - 1. A singular source of fly ash shall be used for all work.
- C. Plasticizing: ASTM C1017/C1017M Type I, plasticizing.

2.3 **ACCESSORIES**

- A. Bonding agent: Two component modified epoxy resin.
- B. Vapor retarder: ASTM E1745 Class A 6 mil thick clear polyethylene film recommended for below grade application. Furnish manufacturer-recommended joint tape.
- C. Waterstop:
 - 1. For new concrete: Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 6-inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.
 - a. Manufacturer:
Polyvinyl chloride waterstop shall be Greenstreak Standard style 732 or equal. Substitutions: Section 01 60 00 - Product Requirements.
 - 2. For new concrete, abutting existing concrete: Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.
 - a. Provide Waterstop-RX 102 bentonite waterstop and water-based adhesive as manufactured by Colloid Environmental Technologies Company (CETCO); or equivalent.
 - b. Waterstop shall consist of 75 percent sodium bentonite and 25 percent butyl rubber compound formed into uniform coils.

- c. 3/4-inch by 3/8-inch by 25-foot rolls of flexible strip of bentonite and butyl rubber compound for use in concrete construction joints. Not designed for expansion joints.

C. Expansion Joints:

1. Expansion joint filler shall be flexible, lightweight, non-staining, polyethylene, and closed cell. It shall be a chemical-resistant, ultraviolet stable, non-absorbent, low density, compressible foam and have the following requirements.
 - a. Density, ASTM D1751: 2.0 lbs/cu.ft. (32.04 kg/cu. m)
 - b. Compression, ASTM D3575
 - 1) 10% Deflection: 10 psi (69 KPa) maximum.
 - 2) 80% Deflection: 125 psi (862.49 KPa) max.
 - c. Tensile Strength, ASTM D3575: 55 psi (379.50 KPa)
 - d. Water Absorption, ASTM D3575: 0.5% vol. maximum.
 - e. Temperature Stability: -40°C to 71°C (-40°F to 160°F).

2.4 CONCRETE MIX

- A. Select proportions for normal weight concrete in accordance with ACI 301 Method 1.
- B. Provide concrete to the following criteria for footings, footing walls, and floor slab:

Material and Property	Measurement
Compressive Strength (7-day)	3,000-psi (Slab on Grade) 4,000-psi (Walls and Footings)
Compressive Strength (28-day)	4,000-psi (Slab on Grade) 5,000-psi (Walls and Footings)
Cement Type	ASTM C150 - Minimum 6.5 sacks per cubic yard (611-pounds cement) -Fly ash may be substituted for up to 15 percent of total required cement content.
Aggregate Type	Normal weight
Water-Cement Ratio (maximum)	0.5 by weight
Air Content	1.5 percent plus or minus 0.5 percent (Floor Slab) 6.5 percent plus or minus 1.5 percent (all others)
Slump – Vertical Wall Sections	3-inches plus or minus 1-inch
Slump – Footings, Slabs	4-inches plus or minus 1-inch

- C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Engineer.
 1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
 2. Do not use calcium chloride nor admixtures containing calcium chloride.
 3. Use set retarding admixtures during hot weather, only with Engineer's authorization.
 4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing or deicing chemicals.
 5. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fume, and slag.
- D. Average compressive strength reduction: Not permitted.

- E. Ready mixed concrete: Mix and deliver concrete in accordance with ASTM C94/C94M.
- F. Site mixed concrete: Mix concrete in accordance with ACI 318.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout or epoxy in accordance with Drawings or manufacturer's recommendations.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.
 - 1. Bottom of excavations shall be undisturbed earth free of frost or debris, level and compacted.
 - 2. Do not place any concrete until the Engineer has inspected and authorization forms and soil conditions, and until reinforcing, sleeves, and embedded items have been placed.
 - 3. Clean all dirt and debris from transporting equipment.
 - 4. Clean reinforcement of all foreign matter.
 - 5. Clean forms and oil or wet (except in freezing conditions) surfaces.
 - 6. Compact, level, and dampen base fill material under slabs on grade.
 - 7. Prior to placing concrete, install polyethylene vapor barrier under interior slabs.
 - 8. Do not puncture or otherwise damage vapor barrier or membrane waterproofing.
- E. Transport concrete to prevent separation of materials in accordance with ACI practices:
 - 1. Do not add water to concrete during transporting.
 - 2. Handle from mixer to point of placement with carts, buggies, or conveyors.
 - 3. Do not dump concrete from mixer or from transporting equipment with a free fall of more than 3-feet.
 - 4. Deposit concrete as nearly to its final position as possible.
 - 5. Clean transporting equipment at frequent intervals during placement.
 - 6. Do not use partially hardened or contaminated concrete.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify testing laboratory and Engineer minimum 48-hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and accessories are not disturbed during concrete placement.

- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by sealant applied between overlapping edges and ends or taping edges and ends.
- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.
- F. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler.
- G. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
- H. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish.
- J. Install joint covers in longest practical length, when adjacent construction activity is complete.
- K. Deposit concrete at final position. Prevent segregation of mix. Deposit concrete continuously or in layers of such thickness so no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- L. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- M. Consolidate concrete.
- N. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- O. Place concrete continuously between predetermined expansion, control, and construction joints.
- P. Do not interrupt successive placement; do not permit cold joints to occur.
- Q. Place floor slabs in saw cut pattern indicated.
- R. Saw cut joints within 24-hours after placing. Use 3/16-inch thick blade, cut into 1/4 depth of slab thickness.
- S. Screed floors and slabs on grade level, maintaining flatness of maximum 1/4 inch in 10-ft.
- T. Work concrete into corners and around reinforcement.
 - 1. Machine vibrate sufficiently to insure thorough compaction and complete embedment of reinforcing.
 - 2. Stop placement at point of no shear, or where directed, and erect tight, plumb dams through forms.
 - 3. Place concrete between construction joints in one continuous operation.
 - 4. Locate construction joints in slabs under partitions.
 - 5. Brush on neat cement when pouring against hardened concrete.
- U. Placing concrete forms:
 - 1. Deposit concrete in forms in horizontal layers not deeper than 24-inches and in a

- manner to avoid inclined construction joints.
2. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 3. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
 4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6-inches into preceding layer. Do not insert vibrators into lower layers of concrete which have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- V. Placing concrete slabs:
1. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 2. Consolidate concrete during placing operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Bring slab surfaces to correct level with straight edge and strike off. Use bull floats or derbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 4. Maintain reinforcing in proper position during concrete placement operations.
- W. Cold weather placing:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306, "Cold Weather Concreting", and as herein specified.
 2. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 40°F and not more than 80°F at point of placement, and maintain minimum temperature over the entire work for no less than 72 hours.
 3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 4. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical acceleration unless otherwise accepted in mix designs.
- X. Hot weather placing:
1. When hot weather conditions exist which could seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 "Hot Weather Concreting" and as herein specified.
 2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled or chopped ice may be used to control temperature provided water equivalent of ice is calculated in total amount of mixing water.
 3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 4. Wet forms thoroughly before placing concrete.
 5. Use water-reducing retarding admixture (Type A) when required by high temperatures, low humidity, or other adverse placing conditions.
- Y. Construction joints: Contractor to submit placement and type of construction joints to Engineer for review prior to placement of any concrete on the project.
- Z. Expansion joints:

1. Install expansion joint filler where interior slabs abut exterior walls, interior bearing walls and columns, at perimeter of concrete equipment pads, and other necessary locations as determined by Engineer.
2. Omit expansion joint filler and install 15-pound felt, centered below doors, to break bond at exterior doors with concrete platforms, unless otherwise shown on the Drawings.

3.4 CONCRETE FINISHING

- A. Finish concrete surfaces to requirements of Section 03 35 00.

3.5 CURING AND PROTECTION

- A. Cure and protect concrete surfaces to requirements of Section 03 35 00.

3.6 EQUIPMENT BASES

- A. Furnish bases for all mechanical and electrical equipment where shown on Drawings or specified.
- B. Where required, anchor bolts and template to insure proper location must be furnished by subcontractor concerned.
- C. Finish as specified herein.
- D. Grout under base of all equipment; pack grout to completely fill voids. Grout to be non-shrink and as specified in Section 03 60 00.

3.7 EXTERIOR SLABS

- A. Thickness as shown on Drawings as per Specifications.
- B. Place on 6-inch compacted structural fill or as shown on Drawings. Compact to 98 percent standard proctor.
- C. Slope minimum ¼-inch per foot across slab and/or away from building, unless otherwise shown on Drawings.
- D. Finished as shown in finishing schedule.
- E. Markings: If not otherwise shown, mark across slab at intervals equal to width of sidewalk for sidewalks up to 6-feet wide. For sidewalks over 6-feet wide, mark in squares at approximately 4-feet o.c. each way. Use edging tool along outer edges and joints.
- F. Provide isolation and expansion joints where shown on Drawings and as specified herein under Section 2.5. Isolation joints between sidewalk and adjacent structures and expansion joints at maximum 50-foot intervals where length exceeds 50-feet.

3.8 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Requirements.
- B. Perform field testing in accordance with these Documents.
- C. Provide free access to Work and cooperate with appointed firm.

- D. Concrete inspections:
1. Continuous placement inspection: Inspect for proper installation procedures.
 2. Periodic curing inspection: Inspect for specified curing temperature and procedures.
- E. Slump tests:
1. Make test in accordance with ASTM C143 on sample taken in accordance with ASTM C172.
 2. Tests required:
 - a. First load each day.
 - b. Every 50-cy or fraction thereof.
 - c. Whenever other tests are being made.
 - d. After any change in mix.
 - e. When directed by Engineer.
- F. Temperature tests:
1. Required whenever outside temperature is within 10°F of limiting temperature.
 2. Make tests at same time slump tests are taken.
 3. Use armored thermometer accurate to plus or minus 2°F.
 4. Place thermometer in freshly discharged concrete and leave it in place until reading becomes stable.
- G. Air content tests:
1. By pressure method ASTM C231 or volumetric method ASTM C173 on samples taken in accordance with ASTM C172.
 2. Test first load of air entrained concrete and spot check by additional test on each day when air entrained concrete is placed.
- H. Unit weight of concrete.
- I. Compression tests:
1. Prepare cylinders in accordance with ASTM C31.
 2. Set of 3 cylinders required for every run of 50-cy or fraction thereof.
 3. Cure cylinders under laboratory conditions and test by procedure in ASTM C39.
 4. Prepare additional cylinders and cure under job conditions if air temperature is likely to fall below 40°F.
 5. Break cylinders at 7 and 28-days, or as directed by Engineer.
 6. If over 1 in 10 tests of laboratory specimens fall below specified design compressive strength, check design of mix and make necessary corrections before additional concrete is placed.
 7. When test specimens break below strength specified, Contractor may be required to test concrete affected by procedure in ASTM C42 core tests or load test portion of structure affected.
 8. Remove concrete not in accordance with specifications and replace without cost to Owner.
- J. Record results of all tests immediately in Log of Tests which must be maintained at job site. Log must contain following information:
1. Date and time tests are made.
 2. Test results, if immediately available.
 3. Exact location where tested concrete was placed in structure.
 4. Weather conditions, including air temperature at time tests were made.
 5. Plant and number of mixer truck which delivered concrete.
 6. Name of person who made test.
 7. Mix design number.

3.9 PATCHING

- A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms. Repair defects in accordance with Chapter 9 of ACI 301 and with ACI 309.2R.
- B. Tie holes:
 - 1. After being thoroughly cleaned and dampened, tie holes shall be grouted solid with a nonmetallic, non-shrinking grout.
 - 2. Tie holes shall be filled from the large end of the cone-shaped hole and packed solid by rodding.
 - 3. Rubber plugs shall be placed deep in the wall prior to filling with grout.
 - 4. Holes shall be grouted on both sides of the walls.
 - 5. Grout material shall fill the entire tie hole filling process shall be reviewed with and authorized by the Engineer prior to starting the Work.
- C. Patching minor defects:
 - 1. Surfaces to be patched or repaired after removal of forms shall be by methods reviewed by the Engineer.
 - 2. Plastering over the defects is not allowed.
 - 3. Patching shall be performed as soon as the forms are removed and before any curing compound is applied.
 - 4. Non-shrink, non-staining grout should be used. Provide well-bonded patch to adjacent concrete.
 - 5. Patch imperfections in accordance with ACI 301.
- D. Honeycombing:
 - 1. Excessive honeycomb or embedded debris in concrete is not acceptable.
 - 2. Honeycombing may be a result of improper concrete placement or inadequate vibration.
 - 3. Patching of honeycombing areas may be permissible, depending on the extent and depth of defective concrete and its location.
 - 4. If patching is allowed, all unsound material shall be chipped out back to sound, solid concrete.
 - 5. Patch per Paragraph C above.
 - 6. If patching is not allowed, concrete shall be removed and replaced.

3.10 JOINT FILLERS

- A. Joint cleaning, priming and sealing to be in accordance with sealing manufacturer's recommendations. All joints to be sealed continuously full height in accordance with all product recommendations, under specified environmental conditions.

3.11 PROTECTION OF CONCRETE CONSTRUCTION

- A. All surfaces shall be protected against injury. During the first 72-hours after placing the concrete, any wheeling, working or walking on the concrete shall not be permitted. This does not alter the requirements for proper curing.
- B. Work shall not be performed directly upon newly constructed concrete floor slabs:
 - 1. All newly poured and cured floor slabs shall be covered with heavy cloth or canvas or plastic coated tarpaulins for the duration of the construction period.
 - 2. Remove for periodic cleaning, and replace before continuing construction Work.
 - 3. Remove and dispose of just prior to final inspection.
 - 4. No vehicles of any type shall be operated directly upon newly poured and cured

- floor slabs.
5. No materials placed upon or stored directly on newly poured and cured floor slabs.
- C. Utilize all efforts necessary to protect surface of newly poured floor systems during the remainder of the construction period.
 - D. Do not place concrete slabs or top surfaces of walls during rain unless acceptable protective shelter is provided; and during such weather, all concrete placed within the preceding 12-hours shall be protected with waterproof canvas or other suitable coverings. These shall be provided and kept ready at hand.
 - E. All concrete construction shall be protected from excessive loading. Installation of mechanical and electrical equipment shall be accomplished by employing shores, bearing plates, frames, cranes and temporary beams.

3.12 DEFECTIVE CONCRETE

- A. Defective concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

End.

SECTION 03 35 00

CONCRETE FINISHING

INDEX

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- 1.1 Summary
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- 3.3 Concrete Slab Finishing
- 3.4 Concrete Wall Finishes
- 3.5 Tolerances
- 3.6 Schedule

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finishing Concrete Slabs.
 - 2. Finishing Concrete Walls.
- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 03 10 00 – Concrete Forming and Accessories
 - 3. Section 03 30 00 - Cast-In-Place Concrete

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
- B. ASTM International:
 - 1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on concrete hardener, sealer, curing compounds curing papers, and slip resistant treatment, compatibilities, and limitations.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Finisher: Company specializing in performing work of this section with minimum three (3) year documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver materials in manufacturer's packaging including application instructions.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with concrete placement and concrete curing.

PART 2 – PRODUCTS

2.1 CURING COMPOUNDS

- A. Interior applications: “Kure-N-Seal” waterborne acrylic curing, sealing and dust-proofing compound:
 - 1. Milky white color; dries clear.
 - 2. For curing, apply at rate of 200 to 400 square foot per gallon.
 - 3. Prepare surface and apply per manufacturer’s recommendations.
- B. Exterior applications: “Kure-N-Harden” water-soluble, inorganic, silicate-based curing, hardening, sealing and dustproofing compound:
 - 1. Clear color.
 - 2. Apply at rate of 150 to 200-square feet per gallon.
 - 3. Prepare surface and apply per manufacturer’s recommendations.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify floor surfaces are acceptable to receive the Work of this section.

3.2 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 1. Protect concrete footings from freezing for minimum 7 days.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure concrete floors in accordance with the following:

1. Cover with fabric mats and keep wet during curing period.
 2. Cover with waterproof paper which meets requirements of ASTM C171.
 3. Cover with clear or white polyethylene sheets, 0.004-inch thick. Lap edges minimum 4-inch and seal with tape.
 4. Seal with liquid applied curing and sealing compound applied in accordance with manufacturer's directions. Do not apply compound on construction joints or floors to receive other finishes such as ceramic tile.
 5. Do not use Methods 1 and 4 in unheated areas during cold weather operations if exposed concrete is protected with blanket insulation.
- D. Vertical surfaces:
1. Wood forms, kept wet, and metal forms provide satisfactory curing. Cure exposed top surfaces as specified above.
 2. When forms are removed before end of curing period, exposed concrete must be cured by one of first three authorization methods included under Item C.

3.3 CONCRETE SLAB FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. Complete screeding and darbying slabs before excess moisture or bleeding of water is present on surface.
- C. Do not begin subsequent finishing operations until surface water has disappeared and the concrete will sustain foot pressure with only approximately ¼ inch indentation.
- D. Refer to Schedule, included in this specification section, for finish type at each location, defined as follows:
 1. Float Finish: (Type Slab 1)
 - a. Consolidate concrete with a power-driven disc-type float or a combination floating-troweling machine with metal float shoes attached.
 - b. Machines which have a water attachment for wetting the concrete during the finishing operation are prohibited.
 - c. Where slab drainage is indicated, take care to maintain accurate slopes for drainage.
 2. Steel Troweling: (Type Slab 2)
 - a. Produce a smooth float finish.
 - b. After float finishing, steel trowel surface as specified in Schedule to increase the compaction of fines and to provide maximum density and wear resistance.
 3. Integral Finishes: (Type Slab 3)
 - a. Use for slabs where some material other than concrete will be the final wearing surface.
 - b. Screeded Finish - Place screed blocks at frequent intervals and strike off to surface elevations desired; unless otherwise indicated, use on base slabs upon which grout finish, regular mortar bed ceramic tile, sand cushion terrazzo or similar type wearing surface is applied.
 4. Broom Finish: (Type Slab 4)
 - a. Draw stiff broom over previously floated finish, to obtain non-slip finish.
 - b. Steel Troweled Finish: Screed and bull float or darby. Give preliminary float finish, true, even and free from depressions; float surface with hand or machine floats; compact surface with not less than 2 thorough and complete steel troweling operations.
 - c. Buffing: After concrete floors have been properly cured, buff thoroughly to remove soluble salt incrustation or other foreign substances.

3.4 CONCRETE WALL FINISHES

- A. Complete screeding and darbying of top of walls before excess moisture or bleeding water is present on the surface.
- B. Do not begin subsequent finishing operations until surface water has disappeared.
- C. Refer to Schedule, included in this specification section, for finish type at each location, defined as follows:
 - 1. Rough Form Finish: (Type Wall 1)
 - a. No form facing materials specified.
 - b. Patch tie holes and defects.
 - c. Chip off fins 1/4 inch or more in height.
 - 2. Smooth Form Finish: (Type Wall 2)
 - a. Use a form facing material that will produce a smooth, hard, uniform texture on the concrete.
 - b. Keep seams to a practical minimum.
 - c. Patch tie holes and defects.
 - d. Remove all fins.
 - 3. Smooth Rubbed Finish: (Type Wall 3)
 - a. Produce a smooth form finish.
 - b. Wet surface and rub with a Carborundum brick until uniform color and texture are produced.
 - c. Perform rubbing no later than 24 hours after forms are removed.
 - d. Do not use any cement grout other than the paste drawn from the concrete itself by rubbing.
 - e. Thoroughly wash the surface with water.
 - 4. Smooth Troweled Finish: (Type Wall 4)
 - a. Produce a smooth rubbed finish.
 - b. After wet-rubbing, finish with a steel trowel to increase compaction of fines and to provide maximum density.
 - 5. Smooth Finish (Grout Cleaned): (Type Wall 5)
 - a. Use for architectural surfaces exposed to general view, unless other indicated.
 - b. Mix 1 part Portland cement and 1-1/2 parts fine sand with sufficient water to produce grout having consistency of thick paint; use white Portland cement in combination with normal Portland cement to achieve uniform surface color after drying.
 - c. Wet surface of concrete and uniformly apply grout with brush or spray gun completely filling air bubbles; surface with a wood float scouring wall vigorously.
 - d. Allow grout to partially set for one to two hours, depending on weather conditions; in hot dry weather, keep damp, using fine fog spray.
 - e. When grout has hardened sufficiently to be scraped from wall with edge of steel trowel without removing grout from small air holes, cut off all grout that can be removed with trowel.
 - f. Allow surface to dry thoroughly then rub vigorously with dry burlap to completely remove dried grout; there shall be no visible film or grout remaining after this rubbing.
 - g. The entire cleaning operation for any area must be completed the day it is started; no grout shall be left on overnight, and sufficient time shall be allowed for grout to dry after it has been cut with trowel so it can be wiped off clean with burlap.
 - h. After entire surface has been grout cleaned, wipe off any slightly dark spots or streaks with fine abrasive hone.

3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation of Surface Flatness for Exposed Concrete Floors: 1/4 inch in 10 ft.
- C. Maximum Variation of Surface Flatness under Seamless Resilient Flooring: 1/4 inch in 10 ft.
- D. Maximum Variation of Surface Flatness under Carpeting: 1/4 inch in 10 ft.

3.6 SCHEDULE

- A. Non water retaining structures
 - 1. Foundations and footings (non-exposed) Wall 1
 - 2. Exposed foundations Slab 2 Top, Wall 5 Sides
 - 3. Exposed walls Slab 2 Top, Wall 5 Sides
 - 4. Slabs and floors, Exterior Slab 4
 - 5. Slabs and floors, Interior Slab 3
 - 6. Beams, joints, and bond beams Wall 5
 - 7. Equipment pads Slab 2 Top, Wall 5 Sides
- B. Water Retaining Structures
 - 1. Slabs and bases, Interior and Exterior Slab 2
 - 2. Buried walls, Interior and Exterior Wall 1
 - 3. Exposed walls Slab 2 Top, Wall 5 Sides
 - 4. Fillets Slab 2 Top, Wall 5 Sides

End.

SECTION 03 53 00

CONCRETE TOPPING

INDEX

PART 1 – GENERAL

- 1.1 Section Includes
- 1.2 Related Sections
- 1.3 Reference Standards
- 1.4 Submittals

PART 2 – PRODUCTS

- 2.1 Materials
- 2.2 Mix Design

PART 3 – EXECUTION

- 3.1 Surface Preparation
- 3.2 Placing and Finishing
- 3.3 Protection and Curing

PART 1 – GENERAL

1.1 **SECTION INCLUDES**

- A. Concrete toppings of precast members as shown on the plans.

1.2 **RELATED SECTIONS**

- B. Section 03 30 00: Cast-in-Place Concrete.

1.3 **REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C33-82 – Specification for Concrete Aggregates.
 - 2. ASTM C150-83A – Specification for Portland Cement.

1.4 **SUBMITTALS**

- A. Section 01 30 00 – Submittal Procedures: Submittal Procedures.
- B. Submit design mix and cylinder strength prior to any topping placement.

PART 2 – PRODUCTS

2.1 **MATERIALS**

- A. Portland Cement: STM C150, Type I or III.
- B. Aggregate: Conform to ASTM C33.

- C. Fine Aggregate: Shall be natural sand with the following gradation:

Sieve Size	Percent Passing By Weight
3/8 inch	100
No. 4	95-100
No. 8	66-80
No. 16	45-65
No. 30	25-45
No. 50	5-15
No. 100	0-5

- D. Coarse Aggregate: Shall be crushed stone with the following gradation:

Sieve Size	Percent Passing By Weight
1/2 inch	100
3/8 inch	30-50
No. 4	0-15
No. 8	0-5

- E. Coarse Aggregate to be minimum Class 3 Durability.

2.2 **MIX DESIGN**

- A. Mixture:
1. 590 lb/cu. Yd. minimum cement t.
 2. Fine aggregate and coarse aggregate as required.
- B. Minimum Strength: 4,000 psi at 28 days.
- C. Slump: 6" maximum.

PART 3 – EXECUTION

3.1 **SURFACE PREPARATION**

- A. Surface shall be free of oil, grease, paint or other foreign materials. If not, wet surface, sprinkle on detergent, hand or power brush, and flush thoroughly. Repeat as necessary.
- B. For tank slabs, acid etch surface with commercial muriatic acid (27.9% HCl). Wet down surface before applying acid to help dilute and distribute it. As soon as foaming has stopped, flush down slab until it reacts neutrally to pH paper. Apply acid at rate of 1 gallon/100 sq. ft. of surface.

3.2 **PLACING AND FINISHING**

- A. Concrete Temperature: At time of placing, difference in temperature between topping and receiving surface shall not exceed 10^o F.
- B. Placing: Thoroughly wet receiving surface just prior to placing topping, but allow no pools of water. Broom thin coat of neat cement grout into surface of slab for short distance ahead of topping.
- C. Finishing:

1. Finish by floating with magnesium or aluminum float and two trowelling's.
2. Steel trowel after concrete has hardened sufficiently to prevent excess fine material from working to surface.
3. Finish to smooth surface free from defects and blemishes.
4. Do not sprinkle dry cement or mixture of dry cement and sand directly on surface of wearing course to absorb moisture or to stiffen mix.
5. Final finish texture as shown on the plans or as directed by the Owner.

3.3 **PROTECTION AND CURING**

- A. Protect and cure per Sections 03 30 00 and 03 35 00.

End.

SECTION 03 60 00

GROUTING

INDEX

PART 1 – GENERAL

- 1.1 Summary
- 1.2 References
- 1.3 Submittals
- 1.4 Delivery, Storage and Handling

PART 2 – PRODUCTS

- 2.1 Portland Cement Grout Materials
- 2.2 Non-Shrink Cementitious Grout
- 2.3 Hydraulic Cement Compound
- 2.4 Formwork
- 2.5 Curing

PART 3 – EXECUTION

- 3.1 Examination
- 3.2 Preparation
- 3.3 Installation – Formwork
- 3.4 Mixing
- 3.5 Placing Grout
- 3.6 Curing
- 3.7 Field Quality Control

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portland cement grout.
 - 2. Non-shrink cementations grout:
 - a. Application for self-leveling floor surfacing, pipe joints and / or connections, concrete underlayment and topping as indicated on the Drawings and as required for the construction of all Work.
 - 3. Hydraulic cement compound for water holding structures.
- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society of Testing and Materials:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat

- Needle.
 - 5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - 6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacing and Polymer Concretes.
 - 8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
CRD C621 - Non-Shrink Grout.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product data on grout.
- C. Manufacturer's installation instructions: Submit manufacturer's instructions for mixing, handling, surface preparation and placing epoxy type and non-shrink type grouts.
- D. Manufacturer's certificate: Certify Products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver grout in manufacturer's unopened containers with proper labels intact.
- C. Store grout in a dry shelter, protect from moisture.

PART 2 – PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

- A. Portland cement: ASTM C150, Type I and II.
- B. Water:
 - 1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.
- C. Fine aggregate:
 - 1. Washed natural sand.
 - 2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
 - 3. Free from injurious amounts of organic impurities as determined by ASTM C40.
- D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 NON-SHRINK CEMENTITIOUS GROUT

- A. Manufacturers:
 1. Master Buildings, U.S. Grout Corporation
 2. Sika Corporation USA
 3. Or equivalent.
 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Non-shrink cementations grout: Pre-mixed ready for use formulation requiring only addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.
- C. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1-day	4,000-psi
		7-days	7,000-psi
		28-days	10,000 psi to 10,800-psi

2.3 HYDRAULIC CEMENT COMPOUND

- A. Manufacturers:
 1. Xypex Patch'n Plug
 2. Or equivalent.
 3. Substitutions: Section 01 60 00 – Product Requirements
- B. Hydraulic Cement Compound: Use for concrete patching and repair for concrete water holding structures and manholes, and as directed by Engineer. Apply in strict accordance with manufacturer's recommendations.

2.4 FORMWORK

- A. Refer to Section 03 10 00 for formwork requirements.

2.5 CURING

- A. Prevent rapid loss of water from grout during first 48-hours by use of approved membrane curing compound or with use of wet burlap method.

PARTS 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.3 INSTALLATION – FORMWORK

- A. Construct leakproof forms anchored and shored to withstand grout pressures.
- B. Install formwork with clearances to permit proper placement of grout.

3.4 MIXING

- A. Portland cement grout:
 - 1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
 - 2. Prepare grout with water to obtain consistency to permit placing and packing.
 - 3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3-minutes.
 - 4. Mix only quantities of grout capable of being placed within 30-minutes after mixing.
 - 5. Do not add additional water after grout has been mixed.
 - 6. Capable of developing minimum compressive strength of 2,400 psi in 48-hours and 7,000 psi in 28-days.
- B. Mix and prepare non-shrink cementitious grout in accordance with manufacturer's instructions:
 - 1. Capable of developing minimum compressive strength of 2,400 psi in 48-hours and 7,000 psi in 28-days.
- C. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials.

3.5 PLACING GROUT

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.
- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.

- F. Do not remove leveling shims for at least 48-hours after grout has been placed.

3.6 CURING

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of 3-days.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field testing will be performed in accordance with ACI 318 and under provisions of Section 01 40 00 - Quality Requirements.
- C. Submit proposed mix design of each class of grout to testing firm for review prior to commencement of Work.
- D. Tests of grout components may be performed to ensure conformance with specified requirements.

End.

DIVISION 04 – MASONRY

SECTION 04 05 13

MASONRY MORTARING AND GROUTING

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- 1.1 Summary
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- 2.1 Components
- 2.2 Mixes

PART 3 – EXECUTION

- 3.1 Examination
- 3.2 Preparation
- 3.3 Installation

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes mortar and grout for masonry.
- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 04 20 00 - Unit Masonry

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530 - Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
 - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
 - 2. ASTM C91 - Standard Specification for Masonry Cement.
 - 3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 - 4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 6. ASTM C150 - Standard Specification for Portland Cement.
 - 7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
 - 8. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
 - 9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 10. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
 - 11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 12. ASTM C476 - Standard Specification for Grout for Masonry.
 - 13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.

14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
 16. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
 17. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
 18. ASTM C1329 - Standard Specification for Mortar Cement.
 19. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.
- C. The Masonry Society (TMS):
1. ACI 530 – Building Code Requirements for Masonry Structures.
 2. ACI 530.1 – Specifications for Masonry Structures.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Design data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Cold weather requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot weather requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8-mph.

PART 2 – PRODUCTS

2.1 COMPONENTS

- A. Portland cement: ASTM C150, Type I.
- B. Mortar aggregate: ASTM C144, standard masonry type.
- C. Hydrated lime: ASTM C206, Type S.
- D. Grout aggregate: ASTM C404.
- E. Water: Clean and potable.
- F. Mortar color: Shall be standard gray, unless otherwise indicated by on Drawings or by Owner.
- G. Calcium chloride is not permitted.

2.2 MIXES

- A. Mortar mixes:
 - 1. Use Type S mortar for all work except as indicated below or on drawings.
- B. Mortar mixing:
 - 1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
 - 2. Achieve uniformly damp sand immediately before mixing process.
 - 3. Add water repellent in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
 - 4. Re-temper only within two hours of mixing.
- C. Grout mixes:
 - 1. Bond Beams and Lintels: 2,000 psi strength at 28 days, 8-10 inch slump, premixed type in accordance with ASTM C94 or mixed in accordance with ASTM C476 course grout.
 - 2. Grout for structural masonry: 2,000 psi strength at 28-days; 8-10 inches slump; premixed in accordance with ASTM C476 Coarse grout.
 - 3. Application:
 - a. Coarse grout: For grouting spaces with minimum 4 inches dimension in every direction.
 - b. Fine grout: For grouting other spaces.
- C. Grout mixing:
 - 1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.
 - 2. Add admixtures; mix uniformly.
 - 3. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Request inspection of spaces to be grouted.

3.2 PREPARATION

- A. Apply bonding agent to existing surfaces.

3.3 INSTALLATION

- A. Install mortar and grout in accordance with Section 04 20 00.

End.

SECTION 04 20 00

UNIT MASONRY

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- 2.1 Concrete Masonry Units
- 2.2 Accessories
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- 3.1 Examination
- 3.2 Preparation
- 3.3 Installation
- 3.3 Erection Tolerances
- 3.5 Cleaning
- 3.6 Protection of Finished Work
- 3.7 Schedules

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes concrete masonry units; pre-faced concrete masonry units; decorative concrete masonry; firebrick, clay flue lining, reinforcement, anchorage, and accessories.
- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Section 04 05 13 - Masonry Mortaring and Grouting
 - 4. Section 05 50 00 - Metal Fabrications
 - 5. Section 07 90 00 - Joint Protection

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530 - Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
 - 1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.
 - 4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

5. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
 6. ASTM C55 - Standard Specification for Concrete Brick.
 7. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
 8. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
 9. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
 10. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
 11. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 12. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 13. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 14. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. International Code Council
1. IBC – International Building Code, 2006 Edition, and referenced standards with State of Iowa amendments.
 2. IECC – International Energy Conservation Code, 2006 Edition, and referenced standard with State of Iowa Amendments.
- D. The Masonry Society (TMS)
1. TMS MSJC – Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402, Specifications for Masonry Structures.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Product Data: Submit on all accessories and reinforcement.
- C. For colored block, submit block and mortar samples for selection
- D. Test Data: Submit on concrete masonry units.
- E. Manufacturer's certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept units on site. Inspect for damage.
- C. Store masonry units above ground on level platforms which allow air circulation under stacked units.
- D. Cover and protect against wetting prior to use.
- E. Handle units on pallets or flat bed barrows.
- F. Do not permit free discharge from conveyor units or transporting in mortar trays.

- G. Split-face units:
 - 1. Shall be delivered to the jobsite on covered banded pallets with cardboard between layers.
 - 2. Store pallets in single stacks on level ground and cover with waterproof covering (e.g., tarpaulins) to protect the blocks from inclement weather.
 - 3. Handle blocks carefully to avoid breakage and damage to the finished surfaces.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Cold weather requirements:
 - 1. Do not lay masonry on snow or ice covered bed or frozen surface.
 - 2. Do not lay masonry when temperature of outside air is below 40°F unless provisions are made for heating materials, maintaining temperature of materials, and for additional protection of materials and completed work as set forth herein.
 - 3. Whenever the temperature is below 40°F, protect walls and materials against possibility of wetting and freezing.
 - 4. When temperature is in range of 40°F to 32°F, heat mixing water to produce mortar temperature between 40°F and 120°F. When mortar temperature has been established in range allowed, maintain temperature for successive batches.
 - 5. Do not lay block when air temperature is less than 32°F.
 - 6. Maintain temperature of completed wall above freezing for 24-hours by use of auxiliary heat or insulated blankets. Increase to 48-hours where Type 1 Portland Cement is used in mortar and grout.
 - 7. Use temperature at start of construction. Change in procedure during same day construction not permitted until temperature is above 40°F.
 - 8. If temperature is predicted to fall below 32°F within 24-hours, protection is required.
 - 9. Additionally, comply with all applicable requirements of ACI 530.1 and ASCE 6-88.
- C. Hot weather requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8-mph.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions. Coordinate masonry work with installation of windows and door anchors.

PART 2 – PRODUCTS

2.1. CONCRETE MASONRY UNITS

- A. Hollow load bearing concrete masonry units (CMU): ASTM C90; Normal weight 2000 psi minimum compressive strength on the net area.
- B. Hollow Non-load bearing concrete masonry units (CMU): ASTM C129; normal weight, 2000 psi minimum compressive strength on the net area.
- C. Decorative concrete masonry units: ASTM C90; normal weight, 2000 psi minimum compressive strength on the net area.
 - 1. Split-face concrete masonry units.
 - 2. Provide standard block. Block shall be color as selected by Owner and sealed following installation. See Specification Section 09 96 00.

3. Nominal 8-inch standard block height in all standard block shapes.
 4. Use matching manufacturer-approved water-repellent mortar additive, following manufacturer's instructions.
 5. Masonry cleaner:
 - a. Carefully following manufacturer's instructions. Use Burnished Custom Masonry Cleaner by Prosoco; or equivalent, diluted 1 part to 3 parts clean water.
 - b. Do not power wash.
 - c. Never use Muriatic acid solution or any cleaner containing acid on units
- D. Concrete masonry unit size and shape: Modular sized to thickness as indicated on Drawings. Furnish special units for 90 degree corners, bond beams, lintels, coved base, and bullnosed end and corners.

2.2 **ACCESSORIES**

- A. Single Wythe joint reinforcement: Single width, truss type ASTM A580 Type 304 stainless steel; cold-drawn steel wire, all 9 gauge wires. #120 Truss-mesh.
1. Acceptable manufacturers:
 - a. Dur-o-wall, Inc.
 - b. Heckman Building Products, Inc.
 - c. Masonry Reinforcing Corp. of America.
 - d. Hohmann and Barnard.
 - e. Or equivalent.
- B. Reinforcing steel: ASTM A615/A615M, 60 ksi yield grade, of shape and dimensions as shown on Drawings. Bend all bars cold using standard fabrication procurers for concrete reinforcing bars. See Section 03 20 00.
- C. Prefomed Control Joints: Extruded rubber, ASTM D-2000 2AA-805, performed control joints. Acceptable manufacturers:
 1. Hohmann and Barnard
 2. Dur-O-Wall, Inc.
 3. or equivalent.
- D. Expansion Joint Material: Closed cell polyvinyl chloride foam, recovery of 95 percent, if not compressed more than 50 percent of original thickness.
- E. Ties and anchors:
 1. Dovetail slots or channels: Galvanized steel, minimum 12-gauge. Furnish to formwork crew, together with complete instructions, for installation with forms.
 2. Flexible dovetail masonry anchors:
 - a. 12-gauge by 7/8-inch wide corrugated sheet steel of length required protecting 3-1/2-inches from face of concrete or wire type formed from No. 6 gauge coated steel wire looped and closed for locations not otherwise specified.
 - b. 14-gauge by 1-inch wide crimped sheet steel 5-1/2-inches long for anchoring ends of walls or partitions which abut concrete walls.
 3. Rigid steel anchors: Minimum ¼-inch thick by 1-1/4-inch wide by 24-inch long steel bars with 2-inch right angle bend or cross pin at each end.
 4. Rectangular ties: 3/16-inch with 5 percent copper coating, 2-inch wide by length required to provide minimum 1-inch cover to ends.
 5. Mesh type ties: 20-gauge, ½-inch mesh, galvanized fabric, 2-inch narrower than wall or partition and 16-inches long.
- E. Weeps: CMU flashing pans, sloped to direct moisture to integrated weep spout.

Designed to be built into mortar bed joints to expel moisture to exterior of CMU walls. Drainage mats included and insect guard pre-installed. BlockFlash as manufactured by Mortar net Solutions, or equal.

- F. Cavity vents: Molded polyvinyl chloride grilles, insect resistant.
- G. Lintels: Concrete block bond beams and lintels of size and reinforcement indicated on Drawings.

2.3 INSULATION – Not Used

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other sections.
- B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.
- C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Placing and bonding:
 - 1. Lay solid masonry units in full bed of mortar, with full head joints.
 - 2. Lay hollow masonry units with face shell bedding on head and bed joints.
 - 3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
 - 4. Remove excess mortar as work progresses.
 - 5. Fully bond intersections at external and internal corners.
 - 6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
 - 7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 - 8. Cut mortar joints flush where a finished base is scheduled.
 - 9. Isolate masonry from vertical structural framing members with movement joint as indicated on Drawings.

10. Isolate top of masonry from horizontal structural framing members and slabs or decks as indicated on Drawings.
- D. Weeps and vents: Furnish weeps and vents in outer wythe at 24 inches on center horizontally as shown in the Drawings.
- E. Cavity wall: Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor retarder adhesive.
1. Install cavity drain material continuously at bottom of each cavity above through wall flashing.
- F. Joint reinforcement and anchorage:
1. Install horizontal joint reinforcement 16 inches on center or as shown on the Drawings.
 2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
 3. Place joint reinforcement continuous in first and second joint below top of walls.
 4. Lap joint reinforcement ends minimum 6 inches.
 5. Do not extend horizontal joint reinforcement across control or expansion joints unless otherwise shown on the Drawings.
 6. Reinforce all bond beams with two (2) #5 bars placed 1 inch from bottom web, unless otherwise shown on the Drawings.
 7. Verify that anchorages embedded in concrete attached to structural steel members are properly placed. Embed anchorages in every second joint.
 8. Reinforce corners and intersections by lapping horizontal joint reinforcement by using performed pieces.
 9. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches oc.
- G. Lintels:
1. Install reinforced unit masonry lintels over openings as indicated on the Drawings.
 2. Do not splice reinforcing bars.
 3. Support and secure reinforcing bars from displacement.
 4. Place and consolidate grout fill without displacing reinforcing.
 5. Allow masonry lintels to attain specified strength before removing temporary supports.
 6. Maintain minimum 8 inch bearing on each side of opening.
 7. Where end of lintel crosses expansion or control joint, install bond breaker and expansion sleeve over and beyond joint.
 8. Place all lintels on solid, grout filled course or bond beam.
- H. Grouted components:
1. Remove excess.
 2. Lap splices bar diameters required by code.
 3. Support and secure reinforcing bars from displacement.
 4. Place and consolidate grout fill without displacing reinforcing.
 5. At bearing locations, fill masonry cores with grout for minimum 12 inches both sides of opening, unless otherwise indicated on Drawings.
 6. Work grout into masonry cores and cavities to eliminate voids.
 7. Do not grout in lifts greater than 12 inches without consolidating grout by rodding.
 8. Top of lift shall terminate a minimum of 1 ½ inches from mortar joint, except at opening or top of wall.
 9. Two courses immediately below all beam, lintel and joist bearing points shall be completely filled with mortar. All concrete used in masonry bond beams shall be

structural concrete, per Division 03 of these Specifications.

- I. Reinforced masonry:
 - 1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
 - 2. Place reinforcement bars as indicated on Drawings.
 - 3. Splice reinforcement in accordance with Section 03 20 00.
 - 4. Support and secure reinforcement from displacement.
 - 5. Place and consolidate grout fill without displacing reinforcing.
 - 6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.
 - 7. Hollow unit masonry:
 - a. Lay units to preserve unobstructed vertical continuity of cells to be filled. Flues not smaller than 2-inch by 3-inch, except minimum cell dimension must be 3-inch when grout height exceeds 8-feet.
 - b. Provide cleanout openings at bottom of cells to be filled for every grout pour which exceeds 4-feet in height.
 - c. Clean grout spaces of overhanging mortar, obstructions and debris before grouting.
 - d. Seal cleanout openings after inspection before grouting.
 - e. Prevent grout or mortar from staining face of masonry which will be left exposed or painted by immediately removing any mortar or grout contacting such masonry faces.
 - 8. Placing reinforcement:
 - a. Accurately place and secure vertical reinforcement against displacement from position shown on Drawings.
 - b. Hold vertical reinforcement firmly in place. Use frames or other devices where necessary.
 - c. Place horizontal reinforcements as work progresses.
 - d. Collar joints which receive both horizontal and vertical reinforcements must be not less than ½-inch larger than sum of diameters of horizontal and vertical reinforcement contained therein.
 - e. Wire tie splices in vertical reinforcement and attachment of vertical reinforcement to dowels to provide tight contact with each other. Minimum splice length for #6 bars is 40-inches.
 - f. Where necessary to splice reinforcement at points other than shown on Drawings, location and character of splice must be reviewed by Engineer.
- J. Control joints:
 - 1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
 - a. Exterior walls: 20-feet on center and within 24-inches on one side of each interior and exterior corner.
 - b. Interior walls: 30-feet on center.
 - c. At changes in wall height.
 - 2. Do not continue horizontal joint reinforcement through control joints.
 - 3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
 - 4. Size control joint in accordance with Section 07 90 00 for sealant performance.
- K. Built-in work:
 - 1. As work progresses, install built-in metal door frames, window frames, wood nailing strips, anchor bolts, plates, lintels, columns, beams, and other items to be built-in the work and furnished by other sections.
 - 2. Install built-in items plumb and level.

3. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
 4. Do not build in materials subject to deterioration.
- L. Cutting and fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
 2. Obtain Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.
- M. Joining of Work:
1. Where fresh masonry joins masonry is partially or totally set, clean and lightly wet exposed surfaces of set masonry to assure best possible bond (remove all loose brick and mortar).
 2. Where it becomes necessary for construction purposes to stop off a horizontal run of masonry, rake back 1/2-unit length in each course and, if collar joints are grouted or parged, stop grout or parging 4-inches back of rake (teething will not be permitted without advance review by Engineer).
 3. When grouting is stopped for 1-hour or longer, stop pour 1-1/2-inch below top of last course, except where last course is finishing course.
- N. Cleaning, pointing and sealing:
1. Point up open joints or holes in joints; cut out defective joints and repoint.
 2. Thoroughly clean all exposed masonry; follow manufacturer's recommendation to clean masonry with colored mortar to avoid discoloration.
 3. Job-mixed detergent solution: Solution of trisodium phosphate and laundry detergent, dissolved in water. Proportion in accordance with BIA Technical Note 20 – Revised.
 4. After cleaned surface has dried thoroughly, apply siloxane waterproofing sealer to all exposed exterior brick masonry surfaces in strict accordance with manufacturer's instruction.
 5. Leave surfaces of masonry clean and free of stain.
- O. Cutting:
1. Make all unit cuts, including those for bonding, holes, boxes, etc., with motor-driven masonry saws, using either an abrasive or diamond blade.
 2. Cut neatly and locate for best appearance.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum variation from unit to adjacent unit: 1/32 inch.
- C. Maximum variation from plane of wall: 1/4-inch in 10-ft and 1/2-inch in 20-ft or more.
- D. Maximum variation from plumb: 1/4-inch per story non-cumulative; 1/2-inch in two stories or more.
- E. Maximum variation from level coursing: 1/8-inch in 3-ft and 1/4-inch in 10-ft; 1/2-inch in 30-ft.
- F. Maximum variation of joint thickness: 1/8 inch in 3-ft.
- G. Maximum variation from cross sectional thickness of walls: 1/4 inch.

- H. Maximum variation for steel reinforcement:
 - 1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
 - 2. Plus or minus ½- inch when distance from centerline of steel to opposite face of masonry is 8-inches or less.
 - 3. Plus or minus 1- inch when distance is between 8 and 24-inches.
 - 4. Plus or minus 1-1/4-inch when distance is greater than 24-inches.
 - 5. Plus or minus 2-inches from location along face of wall.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Keep masonry work dry during erection. Cover with waterproof protection membrane at end of day and during shut down periods when work is halted by inclement weather or other reasons.
- C. Maintain protection on partially completed walls at all times and on completed walls until permanent protection is placed.
- D. Protection membrane must overhang each side of wall at least 2-feet and be securely anchored.
- E. Protect sills and ledges from mortar droppings.
- F. Protect door jambs and corners from construction damage. Install barricades at particularly vulnerable locations. Cover building corners with plywood.
- G. Protect exposed external corners subject to damage.
- H. Protect base of walls from mud and mortar splatter.
- I. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- J. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

3.7 **SCHEDULES**

- A. Chemical Building Knock-Out Wall:
 - 1. Interior Walls: Single wythe – 8-inch non-load bearing concrete masonry units.

End.

DIVISION 05 – METALS

SECTION 05 12 00

STRUCTURAL STEEL

INDEX

PART 1 – GENERAL

- 1.1 Section Includes.
- 1.2 Related Sections.
- 1.3 References.
- 1.4 Submittals.
- 1.5 Quality Assurance.
- 1.6 Storage of Materials.

PART 2 – PRODUCTS

- 2.1 Materials.
- 2.2 Fabrication.
- 2.3 Finishes.

PART 3 – EXECUTION

- 3.1 Examination.
- 3.2 Field Connections.
- 3.3 Erection.

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members, lintels, suspension cables, sag rods, struts, and steel items shown on Drawings and not specified elsewhere.
- B. Base plates.
- C. Erection and connecting structural steel frames.

1.2 RELATED SECTIONS

- A. Section 03 10 00 – Concrete Formwork.
- B. Section 03 30 00 – Cast-in-Place Concrete.
- C. Section 04 20 00 – Unit Masonry.
- C. Section 05 50 00 – Metal Fabrications.

1.3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- C. ASTM A490 - Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.
- D. SSPC - Steel Structures Painting Council.

- E. AWS D1.1 - Structural Welding Code.
- F. AISC - Manual of Steel Construction - Eighth Edition.
- G. Where reference is made to one of the above standards, the revision in effect at the time of the notice to proceed shall apply.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submit complete Shop Drawings, checked by fabricator and Contractor.
- C. Clearly show fabrication tolerances.
- D. Erection drawing must include placement dimensions of all cast-in-anchorage. Include required tolerances.
- E. On erection drawings, include schedule of field welding together with appropriate details for field use.
- F. Prepare field connection details along lines indicated on Drawings and submit to Engineer for review.

1.5 QUALITY ASSURANCE

- A. Unless otherwise shown on Drawings or specified, all materials, fabrication, and erection of structural steel on project must meet requirements of latest edition of AISC Specifications for the Design, Fabrication & Erection of Structural Steel for Buildings.
- B. Welds: Conform to requirements of AWS D1.1-79, Structural Welding Code.
- C. High strength bolted connections: Conform to latest edition of AISC Specification for Structural Joints using ASTM A325 or A490 Bolts.

1.6 STORAGE OF MATERIALS

- A. Store structural steel members above ground on platforms, skids or other supports and protect from weather.
- B. Store other materials in weathertight dry place; packaged materials in original unbroken package or container.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Structural steel members:
 - 1. Wide flange Sections: ASTM A992.
 - 2. Angles, plates, channels: ASTM A36.
- B. Structural tubing: ASTM A500, Grade B.
- C. Pipe: ASTM A53, Grade B.

- D. Shear stud connectors: ASTM A108, Grade 1015, forged steel, headed, uncoated.
- E. Electrodes for welding:
 - 1. Conform to latest edition of Specifications for Mild Steel Covered Arc Welding Electrodes (AWS-A5.1) or Specifications for Low Alloy Steel Covered Arc Welding Electrodes (AWS-A5.5).
 - 2. E60 or E70 series suitable for type of current, polarity, position and other conditions of use.
- F. Anchorage inserts: Furnish all inserts cast into concrete or built into masonry and complete information and/or templates for proper location.
- G. Expansion anchors: Shall be Red Head Anchors manufactured by Phillips Dail Co., Kwik-Bolts manufactured by Hilti Fastening Systems; or equivalent.
- H. Elastomeric bearing pads:
 - 1. Shall be of a structural grade conforming to the requirements of Section 25, Division 2 of the AASHTO Standard Specifications for Highway Bridges having a durometer hardness of 50 Durometers.
 - 2. All material shall be new, with no reclaimed material incorporated in the finished bearing pad and containing only neoprene as the raw polymer for the elastomeric compound.

2.2 **FABRICATION**

- A. Fabricate structural steel members in accordance with drawings and as recommended by AISC "Manual of Steel Construction" (most recent edition). Verify all dimensions prior to fabrication.
- B. No substitution of section or modification of details made except upon written authorization of Engineer:
 - 1. Sections full length pieces between connections or splices detailed on Drawings.
 - 2. No built-up lengths will be permitted.
 - 3. No warped or damaged sections used.
- C. Beams coped, butt or otherwise fitted at ends as detailed or as necessary to accommodate connections.
- D. All beam end connections shall be bearing type connections with bolt threads excluded from shear plane.
- E. Use short slots in beam end connection angles. Hole sizes to be as adopted by AISC duplication "Structural Joints Using ASTM A325 or A490 Bolts".
- F. Accurately cut and mill bearing plates to assure full contact of bearing surfaces prior to welding.
- G. Weld all shop connections, unless otherwise noted:
 - 1. Weld bead must be flush or slightly above surface of adjacent components.
 - 2. Welds exposed in finished structure must be neat, uniform, and free of cracks, undercut, overlap, surface holes or slag inclusion and with exposed face reasonably smooth (uniform ripples permitted).
 - 3. Finishing or grinding will not be required except where necessary for clearance or fit with other items.

2.3 FINISHES

- A. Clean surfaces free of scale, rust or foreign matter before applying primer.
 - 1. Sandblast all exposed surfaces in completed building to completely remove mill scale.
 - 2. If paint failure occurs due to improper cleaning, strip all paint from member, properly clean and repaint at no additional cost to Owner.
- B. Unexposed items: Shop prime with one coat Tnemec No. 10-99 red metal primer; or equivalent (2-3.5 mils dft).
- C. Exposed items: Shop prime with two coats Tnemec No. 10-1009 gray metal primer; or equivalent (2-3.5 mils dft each coat).
- D. Do not prime surfaces to be field welded or in contact with concrete.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify field conditions are acceptable and are ready to receive Work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 FIELD CONNECTIONS

- A. Field connections bolted unless otherwise indicated on the Drawings. Use high tensile bolts where indicated. Use A307 bolts for all other bolted connections.
- B. Bolted connections conform to the requirements of Table I AISC Manual of Steel Construction. Bolts ¾- inch minimum diameter complete with washers or as shown on Drawings.
- C. Tighten A307 bolts to a snug tight fit as obtained with the full effort of a man using a spud wrench. Insure all parts are in contact. Use self-locking nuts or upset bolt threads to prevent nuts from backing off. Assembly of high tensile bolted connections to meet requirements of "Specification for Structural Joints Using ASTM A325 Bolts" issued by the AISC.
- D. Field welds shall develop full strength of adjoining members unless otherwise detailed.

3.3 ERECTION

- A. Erect structural steel in accordance with Drawings and as recommended by AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings". Erect individual members so deviation from plumb level and alignment does not exceed 1 in 500.
- B. Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and complete installation of necessary permanent bracing and exterior masonry work.

- C. Do not field cut or alter structural members without the written authorization of the Engineer.
- D. After erection, prime all welds, abrasions and surfaces of primed steel. Use a primer consistent with paint used to provide shop coat.
- E. After erection of galvanized items, touch-up welds and abrasions of galvanized items.

End.

SECTION 05 50 00

METAL FABRICATIONS

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PART 1 – GENERAL

- 1.1 Description
- 1.2 Related Sections
- 1.3 Quality Assurance – Welding
- 1.4 Submittals
- 1.5 Delivery, Storage and Handling
- 1.6 Field Measurements

PART 2 – PRODUCTS

- 2.1 Materials
- 2.2 Fabrication
- 2.3 Steel Lintels
- 2.4 Bollards
- 2.5 Anchor Bolts
- 2.6 Anchors.
- 2.7 Frames for Mechanical Roof Openings.
- 2.8 Stair Relief Angles.
- 2.9 Mounting Brackets and Reinforcing Angles.
- 2.10 Lifting Hooks.
- 2.11 Miscellaneous Items.

PART 3 – EXECUTION

- 3.1 Examination
- 3.2 Preparation
- 3.3 Installation
- 3.4 Adjustment and Cleaning

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Section includes:
 - 1. Fabricated metal items as specified hereinafter.
 - 2. Miscellaneous metal, shapes and plates not specified elsewhere, but shown on Drawings or required for complete construction.

1.2 RELATED SECTIONS

- A. Division 01 – General Requirements.
- B. Section 03 30 00 – Cast-in-Place Concrete.
- C. Section 04 20 00 – Unit Masonry.
- D. Section 09 96 00 – High Performance Coating.

1.3 QUALITY ASSURANCE – WELDING

- A. Steel:
1. Conform to codes for arc and gas welding in building construction of AWS and to AISC specifications.
 2. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale which will withstand vigorous wire brushing may remain.
 3. No welding shall be done when base metal is lower than 0°F.
 4. Quality welding operators in accordance with AWS D1.1. Qualification tests shall be run by recognized testing laboratory approved by Engineer at Contractor's expense.
 5. Welding operators shall be subject to examination for re-qualification using equipment, materials, and electrodes employed in execution of Contract work. Such re-qualification, if ordered by Engineer, shall be done at expense of Contractor.
- B. Aluminum: Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as approved and in accordance with recommendations of AWS.
- C. Reference Standards:
1. American Institute of Steel Construction (AISC):
 - a. Specification for Design, Fabrication, and Erection of Structural Steel for Buildings.
 - b. Code of Standard Practice for Steel Buildings and Bridges.
 - c. Manual of Steel Construction, 8th Edition.
 2. American Society for Testing and Materials (ASTM):
 - a. ASTM A6-82A - Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.
 - b. ASTM A36-81A - Specification for Structural Steel.
 - c. ASTM A48-76 - Specification for Gray Iron Castings.
 - d. ASTM A53-82 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - e. ASTM A108-81 - Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 - f. ASTM A307-82A - Specification for Carbon Steel Externally Threaded Standard Fasteners.
 - g. ASTM A325-82 - Specification for High-Strength Bolts for Structural Steel Joints.
 - h. ASTM A500-82A - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - i. ASTM A501-81 - Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - j. ASTM A570-79 - Specification for Hot-Rolled Carbon Steel Sheet Strip, Structural Quality.
 - k. ASTM A572-82 - Specification for High-Strength Low-Alloy Columbian - Vanadium Steels of Structural Quality.
 - l. ASTM A780-80 - Specification for Repair of Damaged Hot-Dip Galvanized Coatings.
 3. American Welding Society (AWS):
 - a. AWS A2.4-79 - Symbols for Welding and Non-Destructive Testing Including Brazing.
 - b. AWS A5.5-81 - Specification for Low Alloy Steel Covered Arc Welding Electrodes.

- c. AWS A5.17-80 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
- d. AWS D1.1-83 - Structural Welding Code: Steel.
- 4. American National Standards Institute (ANSI): ANSI B94.12-1977 - Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills.
- 5. Steel Structures Painting Council (SSPC).
- 6. Aluminum Association (AA): AA SAS-30 - Specifications for Aluminum Structures.
- 7. American Iron and Steel Institute (AISI).
- 8. American Hot-Dip Galvanizers Association (AHDGA).

1.4 SUBMITTALS

- A. Shop Drawings of items provided detailing materials, section sites, connections, anchors, and painting.
- B. Manufacturer's catalog sheets on manufactured items.
- C. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for expansion anchors
- D. Submit in accordance with Section 01 33 00, Submittal Procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Accept metal fabrications on site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on shop drawings.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials shall conform to latest issue of following Specifications:
 - 1. Steel shapes and plates: ASTM A36.
 - 2. Cold-formed tubing and Pipe: ASTM A500.
 - 3. Hot-formed tubing: ASTM A501.
 - 4. Galvanized steel pipe: ASTM A53, Grade A, Schedule 40, unless noted otherwise.
 - 5. Stainless steel: Exterior and submerged - AISI, Type 316; Interior AISI, Type 304; Bolts and anchors - AISI, Type 316 or 304.
 - 6. Aluminum structural shapes and plates: Alloy 6061-T6 or 6063-T6; conform to referenced specifications and ASTM sections found in AA current construction manual series:
 - a. Aluminum-alloy extruded bars, rods, shapes and tubes: ASTM B221, alloy 6061-T6.
 - b. Aluminum-alloy shapes: ASTM B308, alloy 6061-T6.

- c. Aluminum-alloy sheet and plate: ASTM B-209, alloy 6061-T6 or 6063-T6.
 - d. Aluminum-alloy structural pipe and tube: ASTM B429, alloy 6061-T6 or 6063-T6.
 - e. Aluminum-alloy seamless extruded tubing: ASTM B241, alloy 6061-T6 or 6063-T6.
 - f. Cast aluminum fittings: ASTM B26, alloy 214.
 - g. Forged aluminum fittings: ASTM B247, alloy 6061-T6 or 6063-T6.
 - h. Cast aluminum treads with abrasive surface: Wooster Type 231.
 - i. Aluminum grating treads and landings: Borden Type with 1-1/4" abrasive nosings, or equal.
 - j. Aluminum tread plate: ASTM B209; alloy 6061-T6 or 6063-T6. Supply with angles bearing bars, and cross bars. Plating to carry a uniform loading over the specific length with deflection not to exceed 1/4-inch.
- 7. Connection bolts for steel members: ASTM A325.
 - 8. Anchor bolts: Exterior and submerged-stainless steel unless otherwise indicated; interior-ASTM A307 galvanized; 1/2-inch minimum diameter.
 - 9. Connection bolts for wood members (galvanized unless otherwise shown): ASTM A307.
 - 10. Connection bolts for aluminum: Stainless steel.
 - 11. Cast iron: ASTM A48, Class 35B.
 - 12. Threaded rod: Series 300 stainless steel, unless noted otherwise.
- B. Concrete anchors:
- 1. Wedge anchors:
 - a. Products: 316 stainless steel; Rawl-Stud Anchor by Rawlplug Company, Inc., Wedge Anchor by ITT Phillips Drill Division, Kwik-bolt by Hilti Fastening Systems; or equivalent.
 - b. Usage: In concrete. Do not use wedge anchors when submerged.
 - 2. Sleeve anchors:
 - a. Products: Type 316 stainless steel; Hol-Hugger sleeve anchors by Hilti Fastening Systems, Redhead sleeve anchors by ITT Phillips Drill Division, Rawl Lok/Bolt by Rawlplug Company, Inc.; or equivalent.
 - b. Usage: In masonry.
 - 3. Adhesive anchors:
 - a. Products: Parabond Capsule Anchors with Type 316 stainless steel stud, nuts, and washers, as manufactured by Molly Division; HVU2 Adhesive Capsule with HAS-R 316 anchor rod, as manufactured by Hilti Fastening Systems; Williams Adhesive Anchor System with Type 316 stud assembly as manufactured by Williams Form Engineering Corp.; or equivalent.
 - b. Usage: In concrete, submerged.

2.2 **FABRICATION**

- A. Connections and workmanship:
- 1. Fabricate details and connection assemblies in accordance with drawings and with projecting corners clipped and filler pieces welded flush.
 - 2. Weld shop connections, bolt or weld field connections, unless otherwise noted or specified.
 - 3. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
 - 4. Use connections of type and design required by forces to be resisted and to provide secure fastening.

5. Welding:
 - a. Grind exposed edges of welds to 1/8-inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.
 - b. Prepare welds and adjacent areas such there is:
 - i. No undercutting or reverse ridges on weld bead.
 - ii. No weld spatter on or adjacent to weld or any other area to be painted.
 - iii. No sharp peaks or ridges along weld bead.
 - c. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
 6. Bolting:
 - a. Draw up bolts or nuts tight, and deform threads where possible. Use bolts of lengths required so bolts do not project more than 1/2-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
 - b. Provide holes required for connection of adjacent or adjoining work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of $\pm 1/16$ -inch of exact dimensions indicated.
- B. Fit work together in fabrication shop and deliver complete or in parts, ready to be set in place.
- C. Galvanizing:
 1. Galvanize after fabrication.
 2. Galvanize by hot-dip process conforming to appropriate ASTM and AHDGA specifications.
 3. Galvanize in plant having facilities to produce quality coatings and capacity for volume of work.
 4. Ship and handle manner avoiding damage to zinc coating.
- D. Painting and finishes:
 1. Refer to specification Section 09 96 00 High-Performance Coatings.
 2. Paint aluminum in contact with concrete in accordance with AA SAS-30. Under no circumstances shall aluminum contact dissimilar metal.

2.3 STEEL LINTELS

- A. Provide steel lintels over doors, louvers, grille openings, wall recesses, duct openings, and other openings in masonry walls as noted and wherever reinforced concrete or masonry lintels are not provided.
- B. Fabricate lintels from structural shapes as detailed, selected for straightness of section.
- C. Unless otherwise shown, lintels shall have minimum bearing of 8-inch at each side of opening.
- D. Fabricate lintels of multiple sections by welding, grind exposed welds smooth.
- E. Openings less than 4-feet in width not having reinforced masonry shall have a standard W or S-section and plate or double angle steel lintel (as shown on the Drawings).
- F. For double angles the total width of horizontal angle legs shall be 1-inch less than wall thickness. Angles shall be welded together. Masonry lintels shall conform to Section 04 20 00.

2.4 BOLLARDS

- A. Bollards: Steel pipe, concrete filled, crowned cap, 6-inches diameter, with HDPE bollard sleeves, length as indicated on Drawings; prime paint steel pipe, one coat.
 - 1. HDPE bollard sleeves shall be yellow with reflective strips for high visibility.
- B. Concrete Fill: 4,000 psi as specified in Section 03 30 00.
- C. Anchors: Concealed type as indicated on Drawings:
 - 1. Finish: Prime paint, one coat.

2.5 ANCHOR BOLTS

- A. Anchor Rods: ASTM A307; Grade A or as indicated on Drawings.
 - 1. Shape: Straight.
 - 2. Furnish with nut and washer; unfinished.

2.6 ANCHORS

- A. Furnish anchors for frames, curbs, sills, and other metal fabrications anchored into concrete or masonry:
 - 1. Fabricate anchors from strap iron, bent to shape, or of weldable studs, welded to backs of members.
 - 2. Where size and spacing are not noted, furnish 1-1/2-inch by 1/4-inch anchors for concrete and 1-1/2-inch by 1/8-inch anchors for masonry.
 - 3. Space masonry anchors to fit jointing of adjacent masonry work; in concrete, space anchors at 2-feet on centers.
- B. Where anchors and plates or clips are to be built in for attachment of later work, provide bolts in plates for clips, welded to back, with threaded ends extended as required.
- C. For attaching work to masonry or concrete where anchors or inserts cannot be built in, provide expansion anchors and machine bolts or screws.

2.7 FRAMES FOR MECHANICAL ROOF OPENINGS

- A. Structural steel.
- B. All welded construction.
- C. Coordinate with building materials and building contractor.

2.8 STAIR RELIEF ANGLES

- A. Stainless steel.

2.9 MOUNTING BRACKETS AND REINFORCING ANGLES

- A. 316 SS unless noted otherwise.
- B. Anchorage as shown on Drawings.

2.10 LIFTING HOOKS

- A. Steel, galvanized after fabrication.

- B. Verify exact type and location with Engineer in field.

2.11 MISCELLANEOUS ITEMS

- A. Fabricate miscellaneous steel and aluminum framing, supports, and items not forming part of structural steel framework or not indicated to be furnished under structural steel work. Use structural steel plates, shapes, bars, and tubing of sizes and arrangement indicated.
- B. Partial list follows:
 - 1. Guard posts or bollards.
 - 2. Miscellaneous structural steel.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
- B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

- A. General:
 - 1. Erect to lines and levels, plumb and true, and in correct relation to adjoining work. Secure parts using concealed connections whenever practicable.
 - 2. Plumb and true vertical members to tolerance of $\pm 1/8$ -inch in 10-feet. Level horizontal members to tolerance of $\pm 1/8$ -inch in 10-feet.
 - 3. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.
 - 4. Drill field holes for bolts. Do not burn holes.
 - 5. New holes or enlargement of unfair holes by use of cutting torch is cause for rejection of entire member.
 - 6. Perform cutting, drilling, and fitting required for installation of metal fabrications.
 - 7. Engineer shall observe field welds before prime painting. Clean slag from welds prior to inspection.
- B. Layout and install connectors such as expansion bolts and anchor bolts to secure metal fabrications to structure.
- C. Concrete anchors:
 - 1. Drill holes in concrete and masonry work with rotary driven twist drills only. Fill voids in masonry with grout.
 - 2. Do not install until concrete has reached specified minimum strength (3,000 psi).
 - 3. Drill bits shall conform to ANSI B94.10 drill bit carbide dimensional standards.

4. Do not install closer than 6-bolt diameters to edge of concrete or masonry, or closer than 12-bolt diameters to another anchor unless detailed on Drawings.
5. Minimum embedment shall be 8-bolt diameters, except 6-bolt diameters embedment is acceptable when bolt is loaded in shear only.
6. Install in accordance to manufacturer's recommendations.

3.4 ADJUSTMENTS AND CLEANING

- A. Field repair of damaged galvanized coatings:
 1. Repair galvanized surfaces damaged during shipping or erection/construction operations.
 2. Repair surfaces using zinc-rich paint.
 3. Prepare surfaces and apply in accordance with ASTM A780, Annex A2.

End.

DIVISION 06 – WOODS, PLASTICS AND COMPOSITES

SECTION 06 10 00

ROUGH CARPENTRY

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- 1.2 Quality Assurance
- 1.3 Submittals
- 1.4 Product Handling
- 1.5 Job Conditions

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- 2.2 Dimension Lumber
- 2.3 Miscellaneous Lumber
- 2.4 Particle Boards
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- 2.6 Wood Treatment by Pressure Process

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- 3.1 Installation, General
- 3.2 Wood Grounds, Nailers, Blocking, and Sleepers
- 3.3 Wood Framing and Forming, General

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Definition: Rough carpentry includes carpentry work not specified as part of other sections and generally not exposed, except as otherwise indicated.
 - 1. Types of work in this section include rough carpentry for:
 - a. Wood framing and forming.
 - b. Wood grounds, nailers, and blocking.

1.2 QUALITY ASSURANCE

- A. Lumber Standards: Manufacture lumber to comply with PS 20 and with applicable grading rules of inspection agencies certified by ALSC Board of Review.
- B. Inspection Agencies: Inspection agencies and abbreviations used to reference with lumber grades and species include following:
 - 1. NLGA - National Lumber Grades Authority.
 - 2. SPIB - Southern Pine Inspection Bureau.
 - 3. WCLIB - West Coast Lumber Inspection Bureau.
 - 4. WWPA - Western Wood Products Association.
- C. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Reference Standards:
 - 1. American National Standards Institute (ANSI):
 - a. ANSI A208.1-1979 - Mat-Formed Wood Particle Board.

2. American Society for Testing and Materials (ASTM):
 - a. ASTM A153-82 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. American Wood Preservers Bureau (AWPB):
 - a. AWPB LP-2 - Standard in Softwood Lumber, Timber, and Plywood Pressure Treated with Water-Borne Preservatives for Above Ground Use.
4. American Wood Preservers Association (AWPA):
 - a. AWPA C2-83 - Lumber, Timber, Bridge Ties, and Mine Ties--Pressure Treatment.
 - b. AWPA C9-777 - Plywood-Pressure Treatment.
5. National Bureau of Standards (PS):
 - a. PS 20-70 - American Softwood Lumber Standard.
6. National Forest Products Association (NFPA):
 - a. Manual for House Framing--Wood Construction Data No. 1.
 - b. National Design Specification for Wood Construction.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for materials listed below:
- B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material.
 1. Preservative Treatment: For each type specified, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and conformance with applicable standards.
 2. For water-borne treatment include statement that moisture content of treated material was reduced to levels indicated prior to shipment to project site.
- C. Shop Drawings: Submit in accordance with Section 01 33 00.

1.4 PRODUCT HANDLING

- A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar material.
 1. For lumber and plywood pressure treated with water-borne chemicals, spacer between each course to provide air circulation.

1.5 JOB CONDITIONS

- A. Coordination: Fit carpentry work to other work, scribe and cope required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other work.

PART 2 – PRODUCTS

2.1 LUMBER, GENERAL

- A. Nominal sizes indicated except as shown by detail dimensions. Provide actual sizes required by PS 20 for moisture content specified for each use.
 1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide seasoned lumber with 19% maximum moisture content at time of dressing and shipment for sizes 2 inch or less in nominal thickness, unless otherwise indicated.

2.2 DIMENSION LUMBER

- A. For light framing (2 inch to 4 inch thick, 2 inch to 4 inch wide) provide following grade, any species:
 1. Construction grade.
 2. Any species of specified grade.
- B. For structural light framing (2 inch to 4 inch thick, 2 inch to 4 inch wide) provide following grade and species.
 1. Construction grade.
 2. Any species of specified grade.

2.3 MISCELLANEOUS LUMBER

- A. Provide wood for support or attachment of other work including cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:
 1. Moisture Content: 19% maximum for lumber items not specified to receive wood preservative treatment.
 2. Grade: Standard Grade light framing size lumber of any species or board size lumber as required. No. 3 Common or Standard grade boards per WCLIB or WWPA or No. 3 boards per SPIB.

2.4 PARTICLE BOARDS

- A. Particleboard Standard: Manufacture and factory-mark each particleboard panel to comply with ANSI A208.1 for grade indicated.
- B. Particleboard Sheathing: Provide grade 2-M-2 (wafer-board) in thickness and for applications indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners and Anchorages: Provide size, type, material, and finish indicated and recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers, and anchoring devices. Provide metal hangers and framing anchors of size and type recommended by manufacturer for each use including recommended nails.
 1. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A153).
- B. Sill Sealer Gaskets: Glass fiber resilient insulation fabricated in strip form for use as sill sealer; 1-inch nominal thickness compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated, in rolls of 50 feet or 100 feet in length.

2.6 WOOD TREATMENT BY PRESSURE PROCESS

- A. Preservative Treatment: Where lumber or plywood indicated as "Trt-Wd" or "Treated" or specified herein to be treated, comply with applicable requirements of AWPA C2 and C9

and of AWPB listed below. Mark each treated item with AWPB Quality Mark Requirements.

1. Pressure-treat aboveground items with water-borne preservatives to comply with AWPB LP-2. After treatment, kiln-dry lumber and plywood to maximum moisture content, respectively, of 19% and 15%. Treat indicated items and following:
 - a. Wood cants, nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that might impair quality of work and units that are too small to use in fabricating work with minimum joints or optimum joint arrangement.
- B. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Securely attach carpentry work to substrate by anchoring and fastening shown and as required by recognized standards.
 1. Countersink nail heads on exposed carpentry work and fill holes.
 2. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Provide wherever shown and required for screeding or attachment of other work. Form to shapes shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1/2 inch wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.3 WOOD FRAMING AND FORMING, GENERAL

- A. Provide framing members of sizes, on spacings, and frame openings shown, or if not shown, comply with recommendations of "Manual for House Framing" of NFPA. Do not splice structural members between supports.
- B. Anchor and nail as shown to comply with NFPA "Recommended Nailing Schedule" in "Manual for House Framing" and "National Design Specification for Wood Construction."

End.

SECTION 06 20 00

FINISH CARPENTRY

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- 1.2 Quality Assurance
- 1.3 Submittals
- 1.4 Delivery and Storage

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- 2.1 Materials

PART 3 – EXECUTION

- 3.1 Coordination
- 3.2 Workmanship
- 3.3 Application of Finish Hardware

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work includes installation of interior window sills, installation of finish hardware and other required finish carpentry.
- B. Related Work specified elsewhere:
 - 1. Section 06 10 00: Rough Carpentry.
 - 2. Section 09 96 00: High-Performance Coatings.

1.2 QUALITY ASSURANCE

- A. Perform finish carpentry work in accordance with the "Quality Standards" of the Architectural Woodwork Institute (AWI).

1.3 SUBMITTALS

- A. General: Comply with pertinent provisions of Section 01 33 00.
- B. Shop drawings for mill work shall indicated materials, component profiles, fastening, jointing details and accessories to large scale.
- C. Samples of all finish.

1.4 DELIVERY AND STORAGE

- A. Deliver all materials to the job site properly marked to identify the structure for which it is intended. Marking shall correspond to marking indicated on the shop drawings. Store in a manner to maintain identification and to prevent damage.
- B. Do not deliver mill work until site conditions are adequate and ready to receive and protect delivered items.

- C. Replacements: In the event of damage, immediately make all necessary repairs and replacements subject to the approval of the Engineer at no additional cost to the Owner.
- D. Protection:
 - 1. Use all means necessary to protect materials of this section before, during and after installation and to protect work and materials of all other trades.
 - 2. Protect finish carpentry items from damage by excessive changes in moisture content.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Lumber:
 - 1. Softwood Lumber: PS 20; graded in accordance with requirements of AWI; maximum moisture content of ten percent (10%) for interior work.
 - 2. Hardwood Lumber: PS 58; graded in accordance with requirements of AWI; maximum moisture content of ten percent (10%).
- B. Sheet Materials:
 - 1. Interior Softwood Plywood:
 - a. Custom grade in accordance with AWI; ND-INT-APA, NN where both faces are exposed.
 - b. MDO-INT-APA or particleboard with suitable smooth face may be used if surface is to receive opaque finish.
 - 2. Wood particleboard:
 - a. CS-236; composed of wood chips with water resistant adhesive of grade to suit application; sanded faces.
 - 3. Plastic Laminate:
 - a. FS-L-P508F, Grade HP, Class 1, color as selected.
 - 4. Solid Surfacing Material:
 - a. Non-porous surfacing material.
 - b. Homogenous composition of natural minerals and high performance acrylic.
 - c. Approved manufacturer: Corian.
- C. Other Materials:
 - 1. Provide all other materials, not specifically described, but required for complete and proper installation, as selected by the Contractor subject to the review of Engineer.

PART 3 – EXECUTION

3.1 COORDINATION

- A. Throughout progress of work, coordinate as required with all other trades to ensure that proper and adequate interface is provided to receive the work of this section.

3.2 WORKMANSHIP

- A. General Requirements:
 - 1. Furnish all rough and finish hardware, accessories, scribe strips, screws, connector blocks and strips, cleats, brads, etc., to provide a complete and operable installation.

2. All units shall fit snugly together and shall be rigidly secured to each other, to the tops and to any subbases.
 3. All methods of attachment shall be such as to avoid any sharp points, burrs, etc., which might bruise or cause laceration in hands, inserted within cases.
 4. All plumbing and electric fittings, trim, piping, etc., will be furnished and installed by others, but this Contractor shall provide holes, openings, etc., and shall make necessary provisions for installing such items in the Finish Carpentry.
 5. Produce joints which are true, tight, and well fastened with all members assembled in accordance with the drawings.
 6. Joints:
 - a. Make joints to conceal shrinkage; miter exterior joints; cope interior joints; miter or scarf end-to-end joints.
 - b. Install trim in pieces as long as possible, jointing only where solid support is obtained.
 7. Fastening:
 - a. Install items straight, true, level, plumb and firmly anchored in place.
 - b. Where blocking or backing is required, coordinate as necessary with other trades to ensure placement of required backing and blocking in a timely manner.
 - c. Fasteners shall be concealed unless condition will not allow and alternate method of fastening is approved by Engineer.
 - d. On exposed work, set fasteners for plugs.
 - e. Screw, do not drive, wood screws; except that screws may be started by driving and then screwed home.
- B. Flashing:
1. No coarse grained sandpaper mark, hammer mark, or other imperfection will be accepted.

3.3 APPLICATION OF FINISH HARDWARE

- A. Receive, store and be responsible for all finish hardware.
- B. Properly tag, index and file all keys.
- C. Apply hardware in accordance with manufacturer's instructions, fit accurately, apply securely and adjust carefully to attain proper operation.
- D. When necessary, remove and replace doors so they may have top and bottom painted.
- E. Prior to completion of the building, examine all doors and other movable parts, adjust as required, leaving hardware in good working order, free from defects.

End.

SECTION 06 72 00

FIBERGLASS STRUCTURAL ASSEMBLIES

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- 1.2 Related Work
- 1.3 Submittals
- 1.4 Design Criteria

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- 2.1 FRP Handrail (Safety Pedestrian)
- 2.2 FRP Stairways and Platforms
- 2.3 FRP Pedestrian Grating
- 2.4 Material Requirements

PART 3 – EXECUTION

- 3.1 Fabrication and Shipping
- 3.2 Installation

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals necessary to install the fiberglass reinforced plastic products as shown on the Contract Drawings and specified herein. Fiberglass reinforced plastic shall be known as FRP throughout this Section.
- B. All gratings, platforms, stairs and handrails construction shall be FRP.
- C. Work in this Section includes, but is not necessarily limited to:
 - 1. FRP handrails.
 - 3. FRP stairways and platforms.
 - 4. FRP gratings.
 - 5. FRP equipment access platforms support and framing members.
 - 6. Miscellaneous FRP shapes as may be required for support and installation of these items.

1.2 RELATED WORK

- A. Section 05 12 00 Structural Steel.

1.3 SUBMITTALS

- A. Submit for approval, in compliance with Section 01 33 00, complete Shop Drawings of all handrails, guardrails, ladders, walkways and stairs, plus other FRP products specified herein. Include strength tests and material composition. Show panel and framing member layouts and complete installation and connection details.
- B. Submit material strength test data along with design calculations and references for all selected components.

- C. Shop Drawings: Provide shop drawings, including engineering calculations, for all fiberglass reinforced structural plastics.
 - 1. Shop and erection drawings and calculations for all FRP components shall be sealed by a professional engineer licensed in the state of the project.

1.4 DESIGN CRITERIA

- A. Design of FRP products shall be in accordance with OSHA structural guidelines, ASTM standard testing procedures, and generally accepted structural design practice.
- B. Design of FRP products shall be the responsibility of the manufacturer and shall be approved by the engineer of record.
- C. Specific design criteria for individual components or structures shall be in accordance with OSHA 29 CFR 1910 Subpart D and as follows:
 - 1. Handrail and guardrails shall be capable of resisting design loads as specified in the ICBO Uniform Building Code.
 - 2. Ladders: Ladders shall be designed for not less than 200-psf superimposed live load. Deflection in inches in any direction for any member shall not exceed the span length in inches divided by 360. Individual rungs shall be designed to support a 200-pound concentrated load placed to produce maximum stress.
 - 3. Ladder shall be capable of supporting design loads as required by uniform building code and OSHA 1910.27 requirements.
 - 4. Ladder design shall comply with OSHA requirements.
 - 5. Floor trench grating: Grating shall be suitable for a concentrated load of 800-pounds applied over a 12-inch by 1-inch area at the midpoint of the spans indicated on the Drawings or a 100-psf uniform load with 1 percent deflection.
 - 6. Equipment access platforms: Superimposed live loads on access platforms shall not be less than 100-psf. Deflection in inches of any member in any direction shall not exceed the span length in inches divided by 360.
 - 7. Stairs and walkways: Stairs and walkways shall be designed for not less than 100-psf superimposed live load. Deflection in inches in any direction for any member shall not exceed the span length in inches divided by 360. Individual stair treads shall be designed to support a 300-pound concentrated load placed to produce maximum stress. Stair stringers shall be designed for the uniform loads noted.
 - 8. All other design criteria as shown on the structural drawings.

PART 2 – PRODUCTS

2.1 FRP HANDRAIL (SAFETY PEDESTRIAN)

- A. Handrail shall conform to the following:
 - 1. Maximum opening anywhere on the handrail assembly shall not be more than 4-inches.
 - 2. Materials: Yellow isophthalic polyester, fire retardant.
- B. Handrail components:
 - 1. Top and mid rail: 2-inch square by 1/4-inch thick tube.
 - 2. Upper post: 1-3/4-inch square by 1/4-inch thick tube.
 - 3. Lower post: 2-inch by 3/8-inch square tubes, maximum 6-foot centers.
 - 4. Handrail solid post connection: 2-inch by 2-inch square solid.
 - 5. Kick or toe plate: 4-inch by 1/2-inch by 1/8-inch double rib profile.
 - 6. Handrail connection clip: 4-inch by 4-inch by 3/8-inch angle.

7. Connection hardware: Type 304 stainless steel, ½-inch diameter bolts, nuts and washers.

2.3 FRP STAIRWAYS AND PLATFORMS

- A. Walkways, platforms and stairways shall be designed and constructed in accordance with OSHA Standards for Fixed Industrial Stairs.
- B. Fabricate from fiberglass pultrusions with Class 1 fire retardance, ASTM E-84 flame spread rating of 25 or less.
- C. Stair treads and angles for the Screening Room – Lower Level shall meet the requirements as described in this spec and as shown on plans.

2.4 FRP PEDESTRIAN GRATING

- A. Construction shall be molded in an integral, one- piece structure which distributes load evenly to bi-directional bearing bars. Glass content shall be not more than 38 percent.
- B. Grating shall be 1-1/2-inch deep by 1-1/2-inch square mesh.
- C. Stair treads shall be 1-1/2-inch deep x 1-foot by 6-inch mesh for maximum strength.
- D. All grating panels will have load bars smooth side surfaces, with no exposed dry glass, voids, or cracks. Top surface shall be covered with epoxy bonded silica grit. Color shall be safety yellow.

2.5 MATERIAL REQUIREMENTS

- A. FRP shapes shall provide Class I fire retardance with an ASTM E84 flame spread rating of 25 maximum.
- B. Color shall be selected by Owner from standard stock.
- C. Fasteners shall be Type 316 stainless steel or vinyl-ester fiberglass reinforced studs and nuts.
- D. All FRP materials shall be resistant to chemicals and solutions found in and around the area of use. FRP manufacturer and the Contractor shall coordinate with the Engineer to verify the chemical resistance of the FRP materials. Submit for review and approval, technical data, and/or test results confirming the resistance of the FRP materials to such chemicals and solutions.
- E. All exposed surfaces shall be smooth and true to form. Stair nosings shall be provided with an embedded grit surface for skid resistance.

PART 3 – EXECUTION

3.1 FABRICATION AND SHIPPING

- A. All FRP access platforms, handrails, guardrails, walkways, and stairs shall be designed, fabricated, and installed by a single manufacturer.
- B. Manufacturers:
 1. American Grating.
 2. Fibergrate.

3. Or equivalent.
- C. FRP fabrications shall be shipped from the manufacturer as follows:
1. Handrail and guardrail shall be supplied in prefabricated sections complete with all couplings, rivets, and adhesive required to assemble the system in the field.
 2. Stairs and platforms shall be shipped as prefabricated and complete, stringer and landing sections along with structural support shapes complete with all fasteners and adhesives required to assemble the platforms in the field.
 3. Ladders and cages shall be supplied completely assembled and ready for installation.
 4. Grating panels shall be shipped banded onto skids and covered with plywood to minimize shipping damage.

3.2 INSTALLATION

- A. All installations shall follow the recommendations of the FRP manufacturer.
- B. All FRP shall be installed securely and shall be level, plumb, and true to line. Provide FRP or Type 316 stainless steel connections to concrete, as recommended by the FRP manufacturer.
- C. All field cuts shall be sealed with material provided by the manufacturer in accordance with the manufacturer's requirements.

End.

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 11 00

DAMPPROOFING

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PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Application of liquid, cold-applied elastomeric waterproofing membrane system to the exterior buried walls of underground wet wells, valve vaults, and tanks.

1.2 RELATED SECTIONS

- A. Section 03 30 00 Cast-in-Place Concrete.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical bulletins and SDS on each product in accordance with Section 01 33 00.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store tightly sealed coating system materials off ground and away from moisture, direct sunlight, extreme heat, and freezing temperatures.
- D. Store in unopened containers in clean, dry conditions at 40°F to 80°F.

1.5 PROJECT CONDITIONS

- A. Environmental requirements:
1. Ensure that substrate surfaces are dry, and ambient air temperatures are 40 to 90°F at application time and remain above 40°F for at least 24-hours after application. Ensure that frost or frozen surfaces are thawed and dry.
 2. Do not apply coatings if snow, rain, fog, and mist are anticipated within 12-hours after application. Allow surfaces to attain temperature and conditions specified before proceeding with coating application.
 3. Do not apply over sealant joints, control joints, or other materials that will be affected by solvent.
 4. Avoid application when inclement weather is present or imminent.
 5. Do not apply membrane to reinforcing bars or to wet or contaminated surfaces.

1.6 REFERENCES

- A. ASTM International:
1. ASTM D41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 2. ASTM D43 – Standard Specification for Coal Tar Primer Used in Roofing, Dampproofing and Waterproofing.
 3. ASTM D449 – Standard Specification for Asphalt Used in Dampproofing and Waterproofing.
 4. ASTM D450 – Standard Specification for Coal-Tar Pitch used in Roofing, Dampproofing and Waterproofing.
 5. ASTM D1227 – Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
 6. ASTM D3747 – Standard Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation.
 7. ASTM D4586 – Standard Specification for Asphalt Roof Cement, Asbestos Free.
 8. ASTM D5643 – Standard Specification for Coal Tar Roof Cement, Asbestos Free.
- B. National Roofing Contractors Association:
1. NRCA – The NRCA Waterproofing and Dampproofing Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. One-component, moisture-curing, bitumen-modified polyurethane, elastomeric waterproofing membrane for exterior below-grade, available by trowel or spray.
- B. Color: Black.
- C. Technical data:

Test or Constituent	Value
Yield	25 to 30-square feet per gallon at 55 to 65-wet mils
Minimum recovery	90 percent
Swelling in water (3-days at room temperature)	Nil
Service Temperature Range: Minimum	-40°F

Service Temperature Range: Maximum	120°F
Hardness, Shore OO	85, ASTM C836
Tensile strength	150-psi, ASTM D412.
Average elongation	600 percent, ASTM D412.
100 Modulus	80-psi, ASTM D412
Moisture-vapor permeability (dry perms)	0.1, ASTM E96.
Extensibility after heat aging	No cracking, ASTM C836.
Weight loss (20 percent maximum)	16 percent, ASTM C836

2.2 ACCESSORIES Not Used

PART 3- EXECUTION

3.1 PREPARATION

- A. Properly cure new concrete minimum of 14-days.
- B. Patch voids and deep depressions in substrates with appropriate patching material before applying waterproofing membrane.
- C. Carefully work material over irregular concrete to avoid pinholes and holidays.
- D. Remove dust, dirt, and other contaminants just before or during application. Ensure surfaces are dry at the time of application.
- E. Open air-void pockmarks or honeycombs up to allow waterproofing membrane to fill cavities completely. Air entrapment within voids may cause blisters. Extreme cases may require a parge coat.

3.2 PRE-STRIPING

- A. Before applying final membrane, seal joints, cracks, and openings around protrusions by caulking or pre-striping (a preliminary coating of waterproofing membrane applied with trowel or stiff bristled brush). Allow drying overnight before applying final membrane.
- B. Static joints and cracks: Fill joints and cracks less than 1/16- inch by pre-striping. Apply material so it both fills and overlaps joint or crack to 4-inch width on each side.
- C. Working or expansion joints: Seal joints over 1/8-inch with joint sealant. Rout moving joints less than 1/8-inch to 1/8-inch minimum and fill with joint sealant. Prevent waterproofing membrane from adhering to joint sealant, which could cause sealant or membrane failure, by applying coat of wax or teflon tape over cured sealant and then pre-striping.

3.3 APPLICATION

- A. For vertical applications, apply by trowel or spray at rate of 25-square feet per gallon. Best results are obtained by marking off 125-square foot area and evenly applying contents of 5-gallon pail.
- B. Verify applied thickness with wet mil gauge as Work progresses.

3.4 INSTALLATION OF PROTECTION COURSE

- A. Install tightly-butted protection board as soon as possible following cure of membrane. Protect membrane from traffic before placement of protection board.

3.5 CURING

- A. Appreciable properties develop within 24 to 48-hours at 75°F and 50 percent relative humidity.
- B. For protection during backfill, install protection board as soon as possible following cure of waterproofing membrane.

End.

SECTION 07 90 00

JOINT PROTECTION

PART 1 – GENERAL

- 1.1 Summary
- 1.2 References
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- 1.4 Qualifications
- 1.5 Environmental Requirements
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- 2.1 General
- 2.2 Joint Sealers
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PART 3 – EXECUTION

- 3.1 Examination
- 3.2 Preparation
- 3.3 Installation
- 3.4 Cleaning
- 3.5 Preparation of Installed Construction

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes sealants and joint backing, and accessories.
- B. Related Sections:
 - 1. Division 01 – General Requirements
 - 2. Division 03 – Concrete.
 - 3. Division 22 – Plumbing: Sealant used in conjunction with mechanical penetrations, fixtures, and equipment.
 - 4. Division 23 – Heating, Ventilating, and Air Conditioning: Sealants used in conjunction with mechanical penetrations, fixtures, and equipment.
 - 5. Division 26 – Electrical: Sealants used in conjunction with electrical penetrations.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 - Standard Specification for Latex Sealants.
 - 2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 - 3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 5. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 6. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- B. Federal Specification Unit (FS):

1. FS TT C 00598 Caulking Compound, Oil and Resin Base Type.
 2. FS TT S 001657 Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.
 3. FS TT S 00230 Sealing Compound: Elastomeric Type, Single Component.
 4. FS TT S 001543 Sealing Compound, Silicone Rubber Base.
- C. Sealing and Waterproofers Institute (SWI):
1. SWI Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
- D. Warranty: Include coverage for installed sealants and accessories failing to achieve watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.
- E. Submit appropriate Safety Data Sheets (SDS).

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.6 PRODUCT STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling provisions.
- B. Deliver the materials to the job site in the manufacturer's unopened containers with all labels intact and legible at time of use.
- C. Store materials in accord with manufacturer's recommendations with proper precautions to ensure fitness of materials when installed.

1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with sections referencing this section.

1.8 WARRANTY

- A. Deliver to Engineer signed copies of the following written warranties against adhesive and cohesive failure of the sealant and against infiltration of water and air through the sealed joints for a period of three (3) years from date of completion.
 - 1. Manufacturer's standard warranty covering sealant materials.
 - 2. Applicator's standard warranty covering workmanship.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Compatibility:
 - 1. Provide joint sealants, joint fillers, and accessory joint materials that are compatible with one another and with joint substrates under project conditions.
 - 2. Install joint sealants, joint fillers, and related joint materials that are nonstaining to visible joint surfaces and surrounding substrate surfaces.
- B. Provide colors selected by Engineer from manufacturer's standard color range, unless otherwise noted.

2.2 JOINT SEALERS

- A. Polyurethane Sealant:
 - 1. Acceptable Manufacturers:
 - a. Sikaflex – 1a.
 - b. or equivalent.
 - 2. Application: Joints which are bordered on one for both sides by porous building materials such as concrete, or masonry or non-porous building material such as painted metal, anodized aluminum, mill finish aluminum, stainless steel, PVC, or porcelain tile.
 - a. Interior and exterior door frame.
 - b. Window frames.
 - c. Louver perimeters.
 - d. Masonry walls.
 - e. Plumbing penetrations.
 - f. HVAC penetrations.
 - g. Electrical penetrations.
 - 3. Backer Rod or Bond Breaker Tape:
 - a. Install backer rod in joint filler applications per manufacturer's recommendations.
 - 4. Color: To match adjacent surfaces.
 - 5. Primer:
 - a. Sikaflex Primer 449.
 - b. or equivalent.
- B. Silicone Sealant:
 - 1. Acceptable Manufacturers
 - a. Dow Corning 786.
 - b. GE Sanitary 1700.
 - c. Tremsil 600.
 - d. or equivalent.
 - 2. Mildew resistant
 - 3. Color: White
 - 4. Applications: Use for joints between plumbing fixtures and floor and wall

surfaces, and joints between countertops and wall surfaces.

- C. Self-Leveling Polyurethane Sealant:
 - 1. Acceptable Manufacturers:
 - a. Tremco THC-900.
 - b. Vulkem 45.
 - c. Or equivalent.
 - 2. Color: To match floor color
 - 3. Application:

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint backing: Polyethylene foam rod or rope or other compatible non-waxing, non-extruding, non-staining resilient material as recommended by sealant manufacturer, closed cell, sized 25 percent wider than joint width.
- D. Bond breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces that is suitable for masking.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces and joint openings are ready to receive work.
- C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Prepare surfaces to receive sealants in accordance with sealant manufacturer's instructions and recommendations.
- B. Examine joint sizes and correct as required to allow for anticipated movement and to achieve proper width/depth ratio per manufacturer's recommendations for specified sealant.
- C. Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer, whether primers are required or not.
 - 1. Remove all traces of previous sealant and joint backer by mechanical methods, such as by cutting, grinding and wire brushing, in manner not damaging to surrounding surfaces.
 - 2. Remove paints from joint surfaces except for permanent, protective coatings.
 - 3. Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.

4. Remove loose materials and foreign matter.
 5. Remove dust by blowing clean with oil-free, compressed air.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions, and SWI "Sealant: Professional's Guide".
- B. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- C. Install bond breaker where joint backing is not used or where recommended by sealant manufacturer, adhering strictly to manufacturers installation requirements.
- D. Install sealants to fill joints completely from the back, without voids or entrapped air, using proven techniques, proper nozzles, and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.
- E. Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Tool sealants in manner that forces sealant against back of joint, ensures firm, full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities. Provide concave tooled joints.
- H. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- I. Pre-compressed foam sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4-inch below adjoining surface.
- J. Compression gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4-inch below adjoining surface.
- K. Install sealant where shown on the drawings and in the following locations:
 1. Sodium Hypochlorite Room floor penetrations.
 2. Locations such as interior and exterior door frames.
 3. Windows.
 4. Louver perimeters.
 5. Masonry Joints.
 6. Plumbing, electrical, HVAC, and process penetrations.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean adjacent soiled surfaces.
- C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 **PROTECTION OF INSTALLED CONSTRUCTION**

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect sealants until cured.

End.

DIVISION 09 – PAINTING AND COATING

SECTION 09 67 26

POLYMER FLOORING

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PART 1 - GENERAL

1.1 SUMMARY

- A. Work described in this Section includes surface preparation and installation of Silikal reactive resin industrial floor system.
- B. See Drawings for locations and quantities.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete.

1.3 SYSTEM DESCRIPTION

- A. The system shall be a composite system of medium-viscosity methacrylic 100 percent reactive binder resin, colored flake fillers, primer and topcoat troweled to minimum thickness of 3/16 inch-1/4 inch.
- B. The coating system shall cure completely and be available to normal operations in no more than 90 minutes at temperatures as low as 35 degrees F after application of the final coat.

- C. The finished floor coating system shall be uniform in color combinations, texture, and appearance. All edges that terminate at walls, floor discontinuities, and other embedded items shall be clean, sharp, uniform, and cosmetically acceptable with no thick or ragged edges.
- D. Polymer concrete shall be utilized to place drainage fillets on the existing monolithically sloped floor to direct flow to floor drains.
- E. The existing system is a Silikal Flake system installed in the early 1990's. This system shall be removed in all areas where the substrate has failed and any other debonded locations. The remaining system shall be thoroughly cleaned as recommended by the manufacturer or removed in areas where cleaning cannot achieve a suitable substrate for placement of a new warrantable system. The new methacrylic system may be placed over the existing system provided the new system is fully warrantable and the finished coating application has a uniformly consistent appearance that is indiscernible from a fully new system placed upon new uncoated concrete. The existing system shall be coated with an opaque pigmented light gray methacrylic resinous system to obscure it from the possibility of being visible through the new flake flooring system.

1.4 **QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
 - 1. The manufacturer shall have successfully marketed and serviced methacrylic resin coating systems for a period of no less than 10 years.
- B. Applicator Qualifications:
 - 1. Pre-qualification requirements: Applicators shall be licensed by the manufacturer to apply the coating system in a warrantable manner.
 - 2. No materials shall be applied by untrained, non-approved personnel.
 - 3. All applicators shall be qualified by the manufacturer as competent in all phases of surface preparation.
 - 4. Each approved applicator must have the following:
 - a. Three (3) years' experience installing methacrylic resinous flooring systems.
 - b. Experience with no less than five (5) methacrylic resinous application projects with verifiable references. At least two of the five projects/references must be of equal size, quantity, and magnitude to this Project.
 - c. Previous projects shall be available for the Engineer to accept or reject as comparable to this Project.
- C. Subcontractor Qualifications:
 - 1. Approved applicators may subcontract with a non-prequalified contractor for shot-blast cleaning of the concrete substrate. The applicator shall have responsibility for assuring preparation is done in a proper warrantable manner.
- D. Acceptance Sample:
 - 1. Representative sample of the specified flooring system shall be submitted to the Owner prior to the bidding phase of the Project.
 - 2. The installed flooring system shall be similar to the acceptance sample in thicknesses of respective film layers, color, texture, overall appearance, and finish.
- E. Bond Testing:
 - 1. Surface preparation efforts shall be evaluated by conducting bond tests in accordance with manufacturer recommendations.

- F. Preconstruction Meeting.
 - 1. A pre-application meeting shall be held with representatives of Owner, General Contractor, Applicator, and material Manufacturer in attendance. The agenda shall include a review and clarification of this specification, application procedures, quality control, inspection and acceptance criteria, and production schedules. Applicator is not authorized to proceed until this meeting has been held or waived by Owner.

1.5 REFERENCES

- A. American Concrete Institute (ACI) 308 – Standard Practice for Curing Concrete.
- B. American Concrete Institute (ACI) 302.1R-80 – Guide for Concrete Floor and Slab Construction.
- C. United States Department of Agriculture (USDA) and (Food and Drug Administration [FDA] authorization) for incidental contact with foodstuffs.

1.6 SUBMITTALS

- A. Acceptance Sample: 12-inch by 12-inch size sample of the specified methacrylic flooring system applied to hardboard or similar backing for rigidity and ease of handling.
- B. Manufacturer's Literature: Descriptive data and specific recommendations for surface preparation, mixing, and application of materials.
- C. Manufacturer's Safety Data Sheets (SDS) for each respective product to be used.
- D. Cleaning and Maintenance recommendations during the coating system service life.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials in original Manufacturer's sealed containers with all original labels intact and legible.
- B. Store materials in dry protected area between 25 degrees and 80 degrees F. Keep out of direct sunlight. Protect from open flame; keep all containers grounded.
- C. Follow all Manufacturer's specific label instructions and prudent safety practices for storage and handling.

1.8 PROJECT SITE CONDITIONS

- A. Material, air, and surface temperatures shall be in the range of 32 degrees to 85 degrees F during application and curing.
- B. Relative humidity in the specific location of the application shall be less than 85 percent and the surface temperature shall be at least 5 degrees F above the dew point.
- C. Minimum conditions required prior to coating of new concrete:
 - 1. Moisture cure concrete for a minimum of 7 days at 70 degrees F. The concrete must be fully cured for a minimum of 28 days prior to application of the coating system pending moisture testing.

2. Surface contaminants such as curing agents, membranes, or other bond breakers must not be present on the surface to receive the coating system.
 3. Concrete shall have a float or darby finish.
 4. Drain trim edges shall be set to the concrete grade rather than raised to the finished grade of the topping. Transition to drain elevation shall be made with the coating system.
- D. Concrete shall have a moisture emission rate of no more than 5 pounds per 1000 square feet per 24-hour period as determined by proper Calcium Chloride Testing. Concrete relative humidity must be 85 percent or less as measured by protimeter. Readings greater than 5 by the Calcium Chloride method or 85 percent by protimeter may require a preliminary treatment with the manufacturer-recommended moisture vapor treatment.
- E. The existing methacrylic flooring system shall be removed in debonded areas, thoroughly cleaned as recommended by the manufacturer, and prepared to properly receive over coating with new material in locations where the existing coating system is suitable to be retained. The existing system shall be fully concealed with an opaque pigmented light gray methacrylic resinous system to prevent it from possibly being visible through the new flake flooring system.

1.9 WARRANTY

- A. Ship materials so as to be substantially free from material defects and suitable to perform in accordance with manufacturer published literature within a period predating their expiration date.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Silikal GmbH, Germany.
- B. Approved Equal complying with all aspects of this Specification.

2.2 MATERIALS

- A. Basis of Design System: Silikal 62 SLF Self Leveling Flake Flooring comprised of the following:
1. Moisture Vapor Treatment - Silikal RE40.
 2. Saturating Primer - Silikal R41 with Additive I.
 3. Patching and Floor contouring for Drainage Slope - Silikal R17 Polymer Concrete.
 4. Coving (required) - Silikal HK20 with #10-#12 mesh, dry silica sand.
 5. Topping - Silikal R62 SL - Silikal R62 resin and Silikal Filler.
 6. Topcoats - Silikal R71re Colorless Silikal Topcoat Resin.
 7. Silikal Flakes (for broadcasting) – Combination selected by Owner comprise of 2 to 3 colors.

2.3 MIXES

- A. Mix products following manufacturer prescribed procedures and recommendations.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine all surfaces to be coated with methacrylic resin system and report to Engineer any conditions that will adversely affect the appearance or performance of the specified coating systems.
- B. Do not proceed with application until surface is acceptable or authorization to proceed is given by Engineer.

3.2 GENERAL

- A. Material storage area must be selected and approved by Applicator and Engineer.
- B. Owner will furnish electricity and water for use by Applicator.
- C. If existing ventilation is inadequate, Applicator will provide sufficient ventilation to allow complete air exchange every 5 minutes.
- D. General Contractor or coating system Applicator shall provide means for disposal of construction waste as a condition of their contract agreement and shall not rely upon the Owner for waste disposal.
- E. Applicator will protect adjacent surfaces not being coated with masking and covers. Owner's equipment shall be thoroughly protected from dust, cleaning solutions, and flooring materials.

3.3 PREPARATION

- A. Surface Preparation - General
 - 1. Concrete substrate must be clean and dry. Remove all dirt, debris, and other deleterious surface accumulations as necessary to properly prepare the substrate to receive the coating system.
 - 2. Prepare new concrete as recommended by the Manufacturer and have the proper conditions to receive the coating application including maturity and moisture content.
 - 3. Surfaces that are contaminated or stained with ferric chloride shall be cleaned in a manner acceptable to the manufacturer.
 - 4. Concrete shall have a moisture emission rate of no more than 5 pounds per 1000 square feet per 24-hour period as determined by proper Calcium Chloride Testing and no more than 85 percent relative humidity as measured by protimeter.
- B. Bond Testing
 - 1. The Applicator shall evaluate all surface preparation and verify its suitability to receive the coating system by conducting bond tests.
 - 2. The Applicator shall recommend to the Engineer for approval locations and quantities for bond tests. A minimum amount of 5 bond tests shall be conducted covering all types of substrates including coverage of the existing coating system, the existing coating system in areas highly stained with ferric chloride prior to preparation work, on new concrete, and on precast concrete walls slightly above the existing coating termination line.
 - 3. Bond Test Procedure

- a. Mix six (6) ounces of the primer to be used in the application with 5 percent powder hardener by volume.
 - b. Add dry quartz sand passing #10-#12 mesh until the mix is a trowel grade consistency.
 - c. Apply 4-inch diameter test patties 1/4-inch thick at each of the approved test locations.
 - d. Allow 1 hour cure time (at minimum 68 degrees F). Test patties must be cured tack-free and allowed to cool to the ambient temperature of substrate.
 - e. Fully remove test patties with hammer and chisel.
 - f. Examine fractured delamination plane. Bond tests pass only when concrete with fractured aggregate remains on the fractured delamination plane of the test patty.
 - g. Additional substrate preparation shall be required if the fractured delamination plane of the test patty contains only laitance without bonded fractured concrete.
4. When further surface preparation is required, a full set of bond tests shall be performed on all substrates that have failed prior bond tests. If there is no surface preparation that produces satisfactory bond tests, the applicator shall report that to the Owner, Engineer, and Manufacturer.
- C. Mechanical Surface Preparation and Cleaning
- 1. Mechanically blast clean all substrate surfaces. Prepare floors using mobile steel shot blasting equipment.
 - 2. Completely remove all surface and embedded accumulations of paint, toppings, hardened concrete layers, laitance, power trowel finishes, and other similar surface characteristics leaving a bare concrete surface having a preparation profile ICRI CSP 5 to CSP 6 (similar to 40 grit sandpaper) and exposing the upper fascia of concrete aggregate.
 - 3. Mechanically abrade vertical surfaces and floor areas inaccessible to the mobile blast cleaning machines to the same degree of cleanliness, soundness, and profile using suitably effective equipment.
 - 4. After blasting, remove traces or accumulations of spent abrasive, laitance, removed toppings, and other debris with brush and vacuum.
 - 5. Conduct Bond Tests to check adequacy of surface preparation.
 - 6. Application of the respective resin systems must be completed before any water or other contamination of the surface occurs otherwise proper preparation shall be repeated.

3.4 **INSTALLATION**

- A. Application methacrylic resin coating system shall include the following:
- 1. Moisture Vapor Treatment.
 - a. Mix moisture vapor treatment products as recommended by manufacturer.
 - b. Pour out all resin onto concrete surface and spread with a squeegee. After approximately 10 minutes remove excess material with squeegee. Roll out remaining resin with a lint-free resin proof roller eliminating all resin films and puddles of material.
 - c. Allow 1 to 3 hours between coats. If a second coat is required per manufacturer recommendations, impregnation of the first coat into the substrate shall be complete.
 - d. Permit no film accumulation on the surface of the treatment and maintain surface texture after every step.

2. Primer Coat.
 - a. Mix primer components according to manufacturer's instructions in batches that can be consumed in 10 to 15 minute pot life of the methacrylic material.
 - b. Apply primer using solvent-resistant paint roller at 9-inch to 18-inch wide with 1/2-inch to 3/4-inch thick-nap or a paint bush in areas inaccessible to a roller.
 - c. Apply primer at a rate of 100 square feet per gallon in a uniform, continuous film, ensuring that all crevices, cracks, other surface discontinuities are saturated and coated. The application shall be free of pools and puddled accumulations.
 - d. Allow the primer coat to fully cure before progressing to the subsequent application.
 - e. Reapply primer to all areas with a dry appearance after priming or areas where primer became fully absorbed into the concrete.
3. Coving.
 - a. Place coving in the coating system along all chemical containment walls and anywhere concrete elements intersect at a cold joint.
 - b. Surface Preparation
 - i. Wall shall be bare concrete or properly prepared to receive coving material before initiating installation of coving materials.
 - c. System Description
 - i. Coving shall be installed according the manufacturer's recommendations
 - ii. Cove base will receive a broadcast and top coat consistent with flooring system.
4. Patching and sloping to floor drains with polymer concrete.
 - a. Mix polymer concrete components as recommended by the Material Manufacturer.
 - b. Use mixture to repair damaged concrete and to sloped areas as needed.
 - c. Once cured, material must be re-primed before next layer is applied.
 - d. Utilize polymer concrete to create drainage fillets in the floor profile in the immediate vicinity of the floor drains.
5. Re-priming polymer concrete drainage fillets.
6. Applying the topping, broadcasting the embedded flakes.
 - a. Size batches and mix according to Manufacturer's instructions. Pour and spread entire batch over floor system.
 - b. Spread the topping material with a gage rake set to a depth of 3/16 inch. Lightly trowel to a uniform thickness of 3/16 inch as necessary.
 - c. Roll with a porcupine roller to release trapped air wherever necessary.
 - d. Broadcast manufacturer recommended flakes in the proper color combination into the fresh material before it begins to cure. Broadcast by tossing upward by hand or using a blower applicator or sandblast pot to achieve an even and uniform broadcast. Flakes must rain down to settle in resin and not be cast directly into uncured resin. Final flake placement shall have a uniform and consistently dispersed appearance without a concentration of color or quantity of flakes in any one location that differs from the remainder of the floor.
 - e. Allow the topping to cure.
 - f. Remove excess flakes by blower and/or vacuuming.
7. Applying the topcoats allowing a minimum cure time of 45 to 60 minute between coat applications until specified thicknesses are achieved.
 - a. Top Coat.
 - i. Mix top coat components according to manufacturer's instructions in batches that can be consumed in 10 to 15 minute pot life of the methacrylic material.

- ii. Apply top coat using solvent-resistant paint roller at 9-inch to 18-inch wide with 1/2-inch to 3/4-inch-thick-nap or a paint bush in areas inaccessible to a roller.
 - iii. Apply top coat with clean rollers at a rate of 80 – 90 square feet per gallon forming continuous film, ensuring that all crevices, voids, other surface irregularities created by flakes are saturated and coated. The application shall be free of pools and puddled accumulations.
 - iv. Allow the initial top coat to fully cure before progressing to the subsequent application.
 - b. Second Top Coat.
 - i. Mix top coat components according to manufacturer's instructions in batches that can be consumed in 10 to 15 minute pot life of the methacrylic material.
 - ii. Apply top coat using solvent-resistant paint roller at 9-inch to 18-inch wide with 1/2-inch to 3/4-inch thick-nap or a paint bush in areas inaccessible to a roller.
 - iii. Apply top coat with clean rollers at a rate of 100 – 120 square feet per gallon forming continuous uniform film creating a monolithic surface appearance free of protrusions or depression or discontinuities in the surface profile.
 - iv. Application shall be free of pools and puddled accumulations to create a floor system with a consistent uniform profile and a uniformly smooth surface texture.
 - v. Allow topcoat to cure.
- B. Open only the containers of component materials to be used in each specific application as needed. Refer to Manufacturer's data sheets for pot-life/temperature relationship to determine size of batches to mix and mix ratios for each respective coat of the system.
- C. Measure, add, and mix powder hardener into the respective resin components in the proportions recommended by the Manufacturer mixing only enough materials to be properly applied within the short pot life of the material.

3.5 FIELD QUALITY CONTROL/INSPECTION

- A. Applicator shall request acceptance of surface preparation from Engineer before application of prime/seal coat.
- B. Applicator shall request acceptance of prime coat from Engineer before application of subsequent specified materials.

3.6 CLEANING

- A. Applicator shall remove any material spatters and other material that is not where it should be. Remove masking and covers taking care not to contaminate surrounding area and dispose of masking materials off site.
- B. Applicator shall repair any damage that should arise from either the application or clean-up effort.

3.7 COATING SCHEDULE

- A. Moisture vapor treatment: Approximately 220 square feet per gallon with 7 mil thickness.

- B. Primer: Approximately 100 square feet per gallon with 16 mil thickness.
- C. Place Patching & Sloping material to form drainage fillets in floor profile.
- D. Place Coving along all containment areas and along cold joint intersections.
- E. Topping (Body) Coat: Spread at uniform thickness of 3/16 inch.
- F. Flakes: Broadcast into the uncured top coat at the rate of 0.15 – 0.25 pounds per square foot.
- G. Clear Top Coats: First coat rate of 80 – 90 square feet per gallon. Second coat rate of 90 – 120 square feet per gallon.

End.

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

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PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Surface Preparation.
 - 2. Surface finish schedule.
 - 3. Paint or coat surfaces described in Painting Schedule shall include, but not be limited to:
 - a. Painting of interior building as shown on the room finish schedule.
 - b. Painting of all exposed process piping and equipment if recommended by the manufacturer.
 - 4. Labeling and directional arrows on piping, equipment with valves or electrical connections, valves, and ducts, whether painted or not.
- B. Related Sections:
 - 1. General Requirements – Division 01 (All Sections).
 - 2. Concrete – Division 03 (All Sections).
 - 3. Metals – Division 05 (All Sections).
 - 5. Plumbing – Division 22 (All Sections).
 - 6. Electrical Conduit – Division 26 (All Sections).
 - 7. Process Integration – Division 40 (All Sections).

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:
 - 1. ASTM D16 – Definitions of Terms Relating to Paint, Varnish, Lacquer and Related Products, Current Edition.

- B. Federal Specification Unit:
 - 1. FS A-A-3054 - Paint, Heat Resisting (204 C).
 - 2. FS QPL-TT-P-28-15 - Paint, Aluminum, Heat Resisting (1200 Deg. F).
 - 3. FS TT-C-555 - Coating, Textured (For Interior and Exterior Masonry Surfaces).

- C. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC Paint 16 - Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint.
 - 3. SSPC SP 2 - Hand Tool Cleaning.
 - 4. SSPC SP 3 - Power Tool Cleaning.
 - 5. SSPC SP 5 - White Metal Blast Cleaning.
 - 6. SSPC SP 6 - Commercial Blast Cleaning.
 - 7. SSPC SP 7 - Brush-Off Blast Cleaning.
 - 8. SSPC SP 10 - Near-White Blast Cleaning.
 - 9. SSPC SP 11 - Power Tool Cleaning to Bare Metal.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

- B. Materials List:
 - 1. Submit complete list of materials and painting schedule for all coats required for each type of surface. Deliver no material to job site until list is reviewed by Engineer.
 - 2. Submit schedule of products proposed for each system if other than those specified in paragraph 2.4, along with complete manufacturer's literature on each coating.
 - 3. List in form permitting identification by container labels.

- C. Shop Drawings:
 - 1. Prepare a complete listing (table) of all items Contractor intends to paint. Do not simply copy these Specifications. Include in the table:
 - a. Paint type intended for use for each specific item or location.
 - b. Space for color selection by Owner. Provide color charts.
 - c. Dry film thickness.
 - d. System type.
 - e. Finish and surface preparation for each coat and each system on list.
 - 2. Color selections:
 - a. May be adjusted by the Engineer after a specific brand of paint has been selected by Contractor and Shop Drawings have been reviewed by Engineer.
 - b. Engineer may specify colors other than those stated in this Section or shown on Drawings.
 - c. Contractor to have the final color selections authorized by the Owner before ordering any painting materials.
 - 3. Duplicate 6 by 8-inch samples of paint and stain colors when requested by Engineer. When possible, apply finishes on identical type materials to which they will be applied on job. Identify each sample as to finish type, formula, color name and number, and gloss.

- D. Samples:
 - 1. Submit two paper chip samples illustrating range of colors available for each

surface finishing product scheduled.

- E. Manufacturer's Installation Instructions: Submit special surface preparation procedures, and substrate conditions requiring special attention.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum 3 years documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
- E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Ensure surface temperatures or surrounding air temperature is above 45°F before applying finishes. Minimum application temperature for epoxy and/or polyurethane coatings is 60°F.
- E. Apply all finishes under adequate illumination.
- F. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures about 45°F for 24-hours before, during, and 48-hours after application of finishes, unless required otherwise by manufacturer's instructions.

1.7 QUALITY CONTROL

- A. Before proceeding with painting, finish one complete sample panel, space, room or item of each color scheme showing selected color, finish texture, and workmanship. Request review and approval by Engineer of first finished sample panel, space room or item. Use first acceptable sample panel, space, room or item as the standard for similar work throughout.

1. Approved samples will be kept on job for comparison;
2. Engineer reserve right to select unopened containers of materials furnished on job and have materials tested at an approved laboratory;
3. Owner will pay for first test. Retests of rejected materials and tests of replacement materials shall be paid for by Contractor. Remainder of contents of containers not require for testing will be returned to Contractor.

1.8 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Leave excess material on premises, where directed by Engineer, usable partial cans of paint.
- C. Containers to be tightly sealed and clearly labeled for identification.

PART 2 – PRODUCTS

2.1 HIGH PERFORMANCE COATINGS

- A. Manufacturers:
 1. Tnemec.
 2. Or equivalent.
 3. Substitutions: Section 01 25 00 – Substitution Procedures.

2.2 COMPONENTS

- A. Coatings – General: Furnish complete multi-coat systems formulated and recommended by manufacturer for applications indicated, and in thicknesses indicated.
 1. Lead content: None.
 2. Maximum VOC content: As required by applicable regulations.
 3. Colors: Selected from manufacturer's Standard Colors.

2.3 COLORS

- A. Architectural colors shall be selected by Owner.
- B. Exposed process piping will be painted in accordance with 10 States Standards, Current Edition.
- C. Exposed conduit and ductwork in finished painted area, except for color coding, shall be painted the color and texture to match walls or ceilings adjacent or near to it or as directed by Engineer.
- D. See color coding and labeling schedule, Part 3.7, for equipment and pipes requiring identification colors.
- E. Equipment colors:
 1. Equipment is meant to include machinery or vessel itself plus structural supports, fasteners, and attached portions of electrical conduit.
 2. Paint portions of equipment same color as process piping it serves.

2.4 COATING SYSTEMS

- A. System A1: Steel – Structural, Tanks, Pipe & Equipment, Immersion (non-potable water) and Interior Service:
 - 1. First coat: N69 Hi-Build Epoxoline II, 3.0-5.0 mdft.
 - 2. Finish coat: N69 Hi-Build Epoxoline II, 4.0-6.0 mdft.

- B. System A2: Steel – Structural, Tanks, Pipe & Equipment, Immersion (potable water) Service:
 - 1. First coat: 91-H2O Hydro-Zinc, 2.5-3.0 mdft.
 - 2. Intermediate coat: 21 Epoxoline, 7.0-10.0 mdft.
 - 3. Finish coat: 21 Epoxoline, 7.0-10.0 mdft.

- C. System B: Steel - Structural, Tanks, Pipe & Equipment, Exterior, Non-Immersion Service:
 - 1. First coat: N69 Hi-Build Epoxoline II, 3.0-5.0 mdft.
 - 2. Intermediate coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft.
 - 3. Finish coat: 1095 Endura-Shield, 2.0-5.0 mdft.

- D. System C: PVC pipe, Exterior, and Galvanized Steel and Non-ferrous metals, Exterior Service:
 - 1. First coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft.
 - 2. Finish coat: 1095 Endura-Shield, 2.0-3.0 mdft.

- E. System D: PVC pipe, Interior Service, and Galvanized Steel and Non-ferrous metals, Interior Service:
 - 1. First coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft.
 - 2. Finish coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft

- F. System E1: Ductile-iron pipe, Interior and Immersion (non-potable water) Service:
 - 1. First coat: N69 Hi-Build Epoxoline II, 3.0-5.0 mdft.
 - 2. Finish coat: N69 Hi-Build Epoxoline II, 4.0-6.0 mdft.

- G. System E2: Ductile-iron pipe, Immersion (potable water) Service:
 - 1. First coat: 21 Epoxoline, 7.0-10.0 mdft
 - 2. Finish coat: 21 Epoxoline, 7.0-10.0 mdft

- H. System F: Ductile-iron pipe, Exterior Service:
 - 1. First coat: N69 Hi-Build Epoxoline II, 3.0-5.0 mdft.
 - 2. Intermediate coat: N69 Hi-Build Epoxoline II, 4.0-6.0 mdft.
 - 3. Finish coat: 1095 Endura-Shield, 2.0-3.0 mdft.

- I. System G: Factory-primed steel, Doors, Frames, Miscellaneous Equipment – Exterior Service:
 - 1. First coat: Factory primed.
 - 2. Intermediate coat: 27 Typoxy, 2.0-3.0 mdft.
 - 3. Finish coat: 1095 Endura-Shield, 2.0-3.0 mdft.

- J. System H: Factory-primed steel, Doors, Frames, Miscellaneous Equipment – Interior Service:
 - 1. First coat: Factory primed.
 - 2. Intermediate coat: 27 FC Typoxy, 2.0-3.0 mdft.
 - 3. Finish coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft.

- K. System I: Concrete and Masonry, Poured-in-Place, Precast & Dense CMU – Exterior Exposed:
 - 1. First coat: 156 Enviro-Crete, 6.0-8.0 mdft.

2. Finish coat: 156 Enviro-Crete, 6.0-8.0 mdft.
- L. System J: Concrete and Masonry, Precast, Poured-in-Place & Dense CMU – Immersion (non-potable) Service:
1. First coat: N69 Hi-Build Epoxoline II, 4.0-6.0 mdft.
 2. Finish coat: N69 Hi-Build Epoxoline II, 4.0-6.0 mdft.
- M. System K: Concrete and Masonry, Precast, Poured-in-Place & Dense CMU – Interior Exposed:
1. First coat: N69 Hi-Build Epoxoline, 6.0-8.0 mdft.
 2. Finish coat: N69 Hi-Build Epoxoline, 6.0-8.0 mdft.
- N. System L: Concrete Floors:
1. First coat: 237 Power Tread, 3.0-5.0 mdft.
 2. Finish coat: 248 EverThane, 2.0-3.0 mdft, containing 2-4 ounces per gallon of polypropylene plastic beads.
- O. System M1: Galvanized Steel and Non-Ferrous Metals – Immersion (non-potable water) Service:
1. First coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft.
 2. Finish coat: N69 Hi-Build Epoxoline II, 2.0-3.0 mdft.
- P. System M2: Galvanized steel and Non-Ferrous Metals – Immersion (potable water) Service:
1. First coat: 21 Epoxoline, 7.0-10.0 mdft.
 2. Finish coat: 21 Epoxoline, 7.0-10.0 mdft.
- Q. System N: Plaster / Wallboard, Interior Service:
1. First coat: 151 Elasto-Grip FC, 0.7 -1.5 mdft.
 2. Intermediate coat: N69 Hi-Build Epoxoline, 4.0 – 6.0 mdft.
 3. Finish coat: N69 Hi-Build Epoxoline, 4.0 – 6.0 mdft.
- R. System O: Wood, Exterior or Interior Service:
1. First coat: 10-99W Tnemec Primers, 2.0 – 3.5 mdft.
 2. Finish coat: 1029 Enduratone, 2.0 – 3.0 mdft.
- S. System P: OSB Board, Interior Moist and Corrosive
1. Prime: Series 151, 300-400 square feet per gallon.
 2. Finish: Two (2) Coats, Series 113 at 200-300 square feet per gallon per coat.
- T. System Q: Concrete and Masonry, Poured-in-Place and Dense CMU – Chemical Containment Area:
1. Filler: 215 Surfacing Epoxy, 1/32” – 1/8” mdft.
 2. Primer: 201 Epoxoprime, 225 sfpg.
 3. Intermediate: 282 Tneme-Glaze, 180 sfpg.
 4. Finish: 282 Tneme-Glaze, 180 sfpg.
- U. System R: Concrete Laminate Floors: Polyurethane concrete system
1. First coat: 241 Ultra-Tread MVT, broadcast aggregate to refusal at 1/8”
 2. Intermediate coat: 237 Power-Tread grout coat, 14-16 mdft
 3. Finish coat: 248 EverThane, 2.0-3.0 mdft.

PART 3 – EXECUTION

3.1 GENERAL

- A. Paint systems shown are to be used for equipment and piping delivered to the site even though they may already be shop primed. Shop-prime coat will not be substituted for the prime coats required by the paint systems listed.
- B. Process equipment directly connected to color-coded pipe shall be painted the same color as the pipe.
- C. Provide surface preparation, materials, equipment, and labor for painting specified.
- D. Apply coating materials and finishes to surfaces of new exposed Work, except surfaces specifically excluded hereinafter. Existing construction shall be painted only where disturbed by new work.
- E. Prime unprimed field-fabricated material in manner specified in this Section.
- F. Touch up factory-applied and other completed finishes using methods and materials which will produce a repaired surface closely matching original finish.
- G. Remove rough areas of structural steel using grinder or other applicable power tools to smooth rough areas on structural steel resulting from cutting and welding.
- H. Paint surfaces of physical hazards in accordance with OSHA Section 1910.144.
- I. Determine compatibility of primers with paints to be applied over them. If priming, undercoating, or finish coating specified does not conform in every way to recommendations of manufacturers, prepare schedule of recommended coatings and submit to Engineer for review. Any resulting changes shall be made at no additional cost to Owner.

3.2 INSPECTION

- A. If surfaces to be finished cannot be put into proper condition for finishing by customary cleaning, sanding and puttying operations or if surfaces were improperly primed by others, immediately report defects to Contractor, in writing, or assume responsibility and rectify any unsatisfactory finish resulting. Commencing of work indicates acceptance of surfaces.
- B. Work removed and replaced to correct surface defects due to procedures on unsuitable surfaces shall be at Contractor's expense.
- C. Where there are questions as to dryness of surfaces test with dampness indicating machine in presence of Engineer. Apply no paint on plaster when moisture exceeds 8 percent as determined by testing device.

3.3 PROTECTION

- A. Adequately protect other surfaces from paint and damage.
- B. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
- C. Place cotton waste, cloths, and material which may constitute a fire hazard in closed

metal containers and remove daily from site.

- D. Protect electrical plates, nameplates, surface hardware, fittings, and fastenings, prior to painting operations. Do not use solvent to clean hardware which may remove permanent lacquer finish.

3.4 SURFACE PREPARATION AND TOUCH-UP

- A. Surface preparation:
 - 1. Shall conform to recommendations of paint manufacturer.
 - 2. Shall conform to these Specifications to ensure satisfactory performance of each coating system.
 - 3. Surfaces, before painting and between coats, shall be dry, smooth, and free from dust, rust, loose mill scale, grease, grit, and frost.
- B. Remove mildew, by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry completely. Use wire brushing only to remove loose dirt.
- C. Rooms and other areas and spaces: Broom-clean before field painting is started.
- D. Aluminum surfaces:
 - 1. Remove surface contamination by steam, high-pressure water, or solvent acid washing.
 - 2. Apply etching primer or acid-etch.
 - 3. Apply paint immediately if etching.
- E. Factory-primed steel: Aggressively sand surfaces of factory-primed steel prior to painting.
- F. Galvanized steel (non-phosphatized) surfaces:
 - 1. Surfaces should be clean and dry. Remove dust and dirt by blowing off the surface with high-pressure air or wiping clean with dry rags.
 - 2. Chemically or mechanically abrade surface to create uniform surface profile.
 - 3. Remove oil, grease and protective mill coatings by solvent cleaning (SSPC-SP1).
 - 4. White rust should be removed from galvanized steel by hand or power brushing. Care should be taken not to damage or remove the galvanizing.
 - 5. Remove rust from old galvanized steel by hand or power tool cleaning (SSPC-SP2 or SP3).
- G. Stainless steel surfaces:
 - 1. Prepared by solvent cleaning prior to coating, using any one of the methods in SSPC-SP1.
 - 2. Only solvents and cleaning solutions containing less than two hundred ppm of halogens should be used to prevent stress corrosion cracking.
 - 3. Abrasive blast cleaning procedures outlined by Steel Structures Painting Council for carbon steel may also be used for stainless steel.
 - 4. Only very hard silica sand or other abrasive media should be used for a fast cutting action and to obtain a sharp angular profile.
- H. Iron and steel:
 - 1. Cleaning methods: Conform to applicable requirements of Steel Structures Painting Council:
 - a. **Solvent cleaning (SSPC-SP1):** Removal of dirt, oil, grease and foreign matter with solvents or commercial cleaners using various methods of cleaning such as wiping, dipping, steam cleaning or vapor degreasing.

Vapor degreasing or steam cleaning should be employed where coatings will not tolerate any oil or grease residue. The removal of oil and grease by solvent cleaning is included in all other SSPC Surface Preparation Specifications.

- b. **Hand tool cleaning (SSPC-SP2):** Removal of loose rust, mill scale, or old paint by hand wire brushing, hand scraping, hand chipping or hand sanding.
 - c. **Power tool cleaning (SSPC-SP3):** Removal of loose rust and mill scale by mechanical means such as power sanders, wire brushes, chipping hammers, abrasive grinding wheels or needle guns.
 - d. **Commercial blast cleaning (SSPC-SP6):** Removal of at least two-thirds (2/3) of all visible rust, mill scale, paint and other foreign matter from each square inch of surface by compressed air nozzle blasting, centrifugal wheels or other specified method.
 - e. **Near-white blast cleaning (SSPC-SP10):** Removal of ninety-five (95) percent of all visible rust, mill scale, paint and other foreign materials from each square inch of surface by compressed air nozzle blasting, centrifugal wheels or other specified method.
2. Blast cleaning requirements:
 - a. Non-immersion: SSPC-SP6.
 - b. Immersion: SSPC-SP10.
 3. Cleaning for other field painting: SSPC-SP3.
 4. Removal of materials such as grease and oil: SSPC-SP1.
 5. Surface irregularities from blasting shall be approximately 30 percent of total paint system dry mil thickness.
 6. Blast profile requirement for all SP6-SP10 abrasive blast-cleaned surfaces to be 1.5-mil.
- I. Ductile-iron pipe:
 1. Inspect surfaces and pre-clean with appropriate solvents to remove grease, oil and other soluble contaminants:
 - a. Scrub surface with stiff bristle brushes soaked in solvent.
 - b. Prior to evaporation remove solvent by wiping with clean, lint-free cloth rags.
 - c. Remove rag residue (if any) with dry, oil free compressed air.
 2. Measure surface profile (anchor pattern) in accordance with ASTM D4417, Method C:
 - a. If the surface profile is less than 1.5 mils, then proceed with brush-off blast cleaning.
 - b. If the surface profile is 1.5 mils or greater, then proceed with hand or power tool cleaning.
 3. Brush-off blast cleaning:
 - a. Removal of all loose annealing oxides, loose rust, dirt and other foreign matter by compressed air nozzle abrasive blast cleaning.
 - b. Any dust or other contaminants remaining after blasting shall be removed with dry, oil free compressed air or by vacuum cleaning.
 - c. Recheck surface profile prior to painting. A profile depth of at least 1.5 mils is required.
 4. Hand or power tool cleaning:
 - a. Removal of all loose annealing oxides, loose rust, dirt and other foreign matter with the use of hand or power tools.
 - b. Do not use cleaning tools which can burnish or smooth the natural roughness (profile) of the cast iron surface.
 - c. Any dust or other contaminants remaining after hand or power tool cleaning shall be removed with dry, oil free compressed air or by vacuum cleaning.
 5. Protect from moisture:

- a. Cleaned iron surfaces shall be protected from conditions of high humidity, rainfall and surface moisture.
 - b. All surfaces must be dry, clean and at least 5°F above the dew point prior to painting.

- K. PVC pipe:
 - 1. All surfaces to be uniformly and thoroughly scarified or abraded to create an anchor profile.
 - 2. Any dust or other contaminants remaining after sanding shall be removed with dry, oil free compressed air or by vacuum cleaning.

- L. Concrete and masonry:
 - 1. All surfaces to be painted or sealed shall be clean, dry and free of dirt, dust, oils, grease, wax, flaking or loose paint, efflorescence and other deleterious materials.
 - 2. All cracks, chips and other defects in plain concrete surfaces shall be filled prior to coating or sealing.
 - 3. New concrete and masonry should not be coated for at least 28-days to permit the concrete or mortar to cure and dry out.
 - 4. Concrete will be tested for moisture content prior to painting by the following method:
 - a. Securely tape a piece of heavy gauge plastic film, about 1-foot square, to the concrete.
 - b. Plastic film will act as a moisture barrier and trap any moisture migrating through the concrete.
 - 5. Film:
 - a. Pieces of test film should be placed at various locations which are likely to be slow drying out, such as below grade, low spots in floors, inside corners and lower wall areas.
 - b. Film should be carefully sealed with tape to prevent the escape of any moisture of vapor which may be trapped behind the film.
 - c. Film should be left in-place overnight or longer to allow sufficient time for moisture migration.
 - d. If condensation appears on the backside of the film or if the concrete under the film appears to be darker, damp or wet, more drying time shall be allowed and the test then repeated.
 - 6. Surface defects and cleaning:
 - a. Surfaces to be coated should be examined for defects such as fins, protrusions, bulges and mortar spatter.
 - b. Defects should be corrected by grinding or scraping.
 - c. Remove non-degraded release agents, oil, wax, and grease by scraping off heavy deposits and solvent cleaning or washing with a hot trisodium phosphate solution consisting of 2-8 oz. of trisodium phosphate to each gallon of hot water (160°F).
 - d. Repeat the cleaning operation until the contamination is removed and flush the area with clean water to remove residual cleaning solution. Allow drying thoroughly before coating.
 - 7. Laitance removal:
 - a. High-build, high film-strength coatings will not develop optimum adhesion to concrete unless laitance and other loosely bound material are first removed from the surface.
 - b. Removal shall be by either acid etching or sandblasting.
 - c. Sandblasting is preferred where practical.
 - 8. Sandblasting:
 - a. Care will be taken to define the degree of blast cleaning required for the coating system so the concrete will not be eroded beyond what is necessary.

- b. Two degrees of abrasive blast cleaning are sufficient for most coating systems:
 - i. Brush-off blast cleaning.
 - ii. Sandblast cleaning.
 - c. Brush-off blast cleaning is lightly abrading the surface without entirely removing the surface or exposing underlying aggregate.
 - d. Brush-off cleaning will open up sub-surface holes and voids and etch the surface sufficiently for the coating to bond and adhere satisfactorily.
 - e. Sandblast cleaning involves the complete removal of the top surface of the concrete, exposing the underlying aggregate.
 - f. Removal of the concrete surface shall not be so deep as to undermine or loosen exposed aggregate.
 - g. Brush-off blast cleaning will meet the requirements for most non-immersion systems, whereas a greater degree of surface removal may be required for some immersion coating systems.
9. Dry sandblasting equipment using a compressed air blast nozzle is recommended:
- a. Wet or water-vapor blast cleaning should be used only with prior approval and where the coating is not scheduled to be applied immediately after surface preparation. Submit dust control plan to Engineer for approval prior to dry sandblasting.
 - b. Abrasive used should be dry silica sand with the maximum particle size which will pass through a 16-mesh screen.
 - c. After blast cleaning is completed, sand, dust and loose particles should be removed from the surface by vacuuming or blowing off with high pressure air.
 - d. Examine the surface for texture and uniformity, as well as the removal of dust, efflorescence and laitance.
 - e. Patch voids and cracks causing discontinuities in the coating or unsightly appearance using a patching compound compatible with the coating system.
10. Compressed air used for nozzle blasting should be periodically checked to verify it is clean, dry and oil free. Oil and water separators should be placed in the airline as close as possible to blast cleaning equipment.
11. Acid etching:
- a. Acid etching solution shall be made with 1 part Muriatic Acid (20° Baume) and 2 to 4 parts of fresh water.
 - b. If a chloride-free acid etching solution is required, 85 percent phosphoric acid diluted with 2 to 3 parts of fresh water shall be used.
 - c. Stronger acid solutions may be used if the etching action is insufficient, but care should be taken not to etch the concrete so deeply the aggregate is not securely bound.
 - d. Residual dust and dirt shall be removed from the surface of the concrete with fresh water, using a high-pressure hose.
 - e. Excess water shall be removed from the floor with brooms or rubber squeegees and the concrete allowed to dry until the surface is damp, but not wet.
 - f. Acid etching solution shall be applied uniformly to the concrete by low-pressure spray equipment or plastic sprinkling cans.
 - g. Spreading operation shall be coordinated with the rinsing operation so acid is not completely spent or has started to dry out before the surface is flushed with fresh water.
 - h. Rinsing operation shall be started when the bubbling action of the acid begins to subside.
 - i. Surface shall be rinsed with clean water, using a pressure hose while scrubbing with stiff bristle fiber brooms to remove salt formations and

- loose material.
 - j. Rinse a second time using a solution of 1-cup of ammonia to 1-gallon of water.
 - k. Test with pH paper and continue the rinsing operation until a pH of 7 or higher is obtained.
 - l. Remove excess water by brooms or rubber squeegees.
 - m. Etched concrete should be examined for uniformity and texture and should have the feel of medium (100-grit) sandpaper.
 - n. Surface should be free of surface glaze, laitance, salts and loosely adhering material.
 - o. Allow the surface to dry a minimum of 72-hours under conditions which will promote drying and then remove all dust and foreign matter by vacuuming.
 - p. Acid etching shall be used to prepare concrete floors. It shall not be used on vertical surfaces and on slopes or inclines.

- M. Gypsum drywall construction:
 - 1. Sand joint compound with fine grit, open-coated sandpaper to provide a smooth flat surface.
 - 2. Avoid heavy sanding of adjacent wallboard, which may raise the nap of the paper covering.
 - 3. Remove dust from the surface by wiping with clean rags or other methods.
 - 4. Putty, patching pencils, caulking or masking tape should not be applied to drywall surfaces to be painted.
 - 5. Lightly scuff-sand tape joints after priming to remove raised paper nap. Take care not to sand through the prime coat and remove dust by wiping with clean rags.

- N. Wood:
 - 1. Wood should be clean and dry.
 - 2. Remove surface deposits of sap and pitch by scraping and wiping clean with rags dampened with mineral spirits. Seal knots and pitch pockets with shellac reduced with equal parts of shellac thinner before priming.
 - 3. Sand rough spots with the grain, starting with medium grit sandpaper and finishing with fine grit. Remove sanding dust.
 - 4. After the prime coat is dry, fill cracks and holes with putty or spackling compound. When filler is hard, sand flush with the surface using fine grit sandpaper.
 - 5. Sand lightly between coats with a fine grit, open-coated sandpaper.

3.5 APPLICATION

- A. Basic application requirements:
 - 1. Spread evenly and flow on smoothly without runs, lumps or sags.
 - 2. Make edges of paint adjoining other materials or colors sharp and clean without overlapping.
 - 3. All previous coats to thoroughly dry before applying succeeding coats.
 - 4. Keep pigments, fillers, varnishes, and enamels well-stirred during application. Paint and finishing materials to be free from skins, lumps or other foreign matter when used. Apply materials without additives and without reducing or thinning.
 - 5. Dry under conditions eliminating possibility of dust becoming impregnated.
 - 6. Manufacturer-applied paint system:
 - a. Abraded areas on factory finished items shall be repaired in strict accordance with manufacturer's directions.
 - b. Repaired areas shall be carefully blended into original finish.

- B. Priming and sealing:
 - 1. Shop:
 - a. Unless specified in other sections, or in following coating schedules, shop primer for ferrous metal shall be minimum 2-coats at 1.0 mil dry film thickness per coat of rust-inhibitive type containing zinc pigments, complying to SSPC guidelines and compatible with appropriate system specified in painting or coating schedules of this Specification.
 - b. Shop primed items shall be inspected at job site for compliance with these specifications. Schedule such inspection with Engineer in advance.
 - c. Areas of chipped, peeled or abraded primer shall be hand or power sanded, feathering edges. Spot prime areas with specified primer.
 - d. Prior to application of finish coats, shop primed surfaces shall be cleaned free of dirt, oil, and grease.
 - e. Holdback areas for welding shall be prepared and primed after welding as required for specified paint system.
 - 2. Field:
 - a. Holdback areas for welding shall be prepared and primed after welding as required for specified paint system.
 - b. Do not field prime surfaces to be submerged.

3.6 SURFACES NOT TO BE PAINTED OR SPECIFIED ELSEWHERE

- A. Painting is not required for surfaces constructed of the following materials or items:
 - 1. Glass, vitreous enamel, and chrome plated items.
 - 2. Stainless steel, aluminum (except where noted), brass, bronze, and copper metals.
 - 3. Rubber, plastic, and fiberglass structural shapes.
 - 4. Switch plates, nameplates, and hardware.
 - 5. Aluminum grating, tread plate, stairs, and handrails.
 - 6. Interior copper piping. Provide pipe markers as specified.
- B. Painting is not required for the following equipment having factory-applied finishes:
 - 1. Motor control centers and similar electrical panels.
 - 2. Heating and ventilating equipment.
 - 3. Lighting fixtures.
 - 4. Meter and instrument panels.
 - 5. Gauges and other miscellaneous equipment.

3.7 PIPE IDENTIFICATION

- A. Paint entire outermost surface of all pipelines located within buildings with specific identifying color; paint compatible with surface painted.
- B. Provide corrosion resistant, snap-on or stick-on type pipe markers for all pipe lines located within buildings with specific identifying code name and flow direction arrows.
 - 1. Space code name with flow arrows at 10-foot intervals.
 - 2. Code name and flow arrow pipe markers shall be manufactured by Seton Name Plate Corp. ; or equivalent, conforming to ANSI A13.1. Specifications.
 - 3. Install per ANSI A13.1 specifications and as observed by Engineer.
 - 4. Consult Engineer for specific names to be used on piping.

C. Pipe identifying colors and pipe markers per Pipe Coding Schedule.

<u>Pipe Markers No.</u>	<u>Service</u>	<u>Coating Color (TNEMEC Color)</u>	<u>Pipe Marker Code Name</u>
1	Non-Potable Water	Olive Green (56GN Moss)	Non-Potable Water
2	Carbon Slurry	Black (35GR Black)	Carbon Slurry
3	Ferric Chloride	Yellow (02SF Safety Yellow)	Ferric Chloride

- D. Color schemes requiring “bands” shall include 1-inch wide bands spaced at 18-inch intervals.
- E. Chemical feed lines and potable water lines of solid PVC/CPVC materials including conduits for chemical feed tubing, and Stainless Steel Compressed Air lines shall NOT be painted, but shall be color coded using pipe banding tape.
1. Tape shall be vinyl with permanent adhesive, Pipe Banding Tape by Seton Nameplate Company.
 2. Tape shall be 2.5” wide and installed at 18” intervals.
 3. Piping requiring a two-color system with a “band” shall have a 2.5” wide band for the primary color and a ¾” band, centered on the primary color, for the secondary band color.

3.8 FINAL TOUCH-UP

- A. Prior to final completion and acceptance, examine painted and finished surfaces and retouch or refinish as necessary and required to leave surfaces in condition acceptable to Engineer.
- B. After doors have been fitted and hung, refinish edges, tops and bottoms.

3.9 CLEANING

- A. As Work proceeds and upon completion, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work keep premises free from any unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Upon completion of work, remove masking, remove paint and varnish spots from floors, glass, and other surfaces and remove rubbish and accumulated materials of whatever nature not caused by other trades from premises and leave in clean, orderly condition, with floors broom clean.

End.

DIVISION 26 – ELECTRICAL

SECTION 26 05 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 26 Sections, in addition to Division I - General Requirements.

1.02 SCOPE OF WORK

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Electrical Systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical System a finished and working system.
- C. Description of Systems shall be as follows:
 - 1. Install the electrical system as indicated on the Project Drawings:
 - a. Pathways and conductors as indicated for process equipment and controls.
 - b. Receptacles and misc. equipment.
 - c. Process sensors and controls.

1.03 WORK SEQUENCE

- A. All construction work that will produce excessive noise levels and interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during non-regular hours. The Owner shall reserve the right to set policy as to when restricted construction hours will be required.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Only products of reputable manufacturers as determined by the Engineer will be acceptable.
 - 2. Each Contractor and his subcontractors shall employ only workmen who are skilled in their respective trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.
- B. Compliance with Codes, Laws, Ordinances:
 - 1. This Contractor shall conform to all requirements of local Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.
 - 2. The current issue of the National Electrical Code shall be followed.
 - 3. If there is a discrepancy between the codes and regulations having Jurisdiction over this installation, and these specifications, the more stringent requirements shall govern.
 - 4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accord with the applicable codes or regulations, he shall inform the Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with his proposal a separate price required to make the system

shown on the drawings comply with the codes and regulations.

5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
- C. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
 2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
 3. Pay all applicable charges for such permits or licenses that may be required.
 4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
 6. Pay any charges by the telephone company related to the service or change in service to the project.
 7. All fixtures, equipment and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)
 8. Underwriters' Laboratories, Inc.
- D. Utility Company Requirements:
1. Secure from Utility Company all applicable guidelines that must be followed to make the job comply with their requirements.
 2. Make the installation comply with the Utility Company requirements.
 3. Make application for and pay for new electrical service equipment and installation.
 4. Make application for and pay for meters and metering equipment as required by the Utility Company.
 5. Make application and pay for any changes and/or removal of existing electrical service by the Utility Company.
 6. It shall be the Contractor's responsibility to verify compliance of meter used with the Utility Company's standards.
- E. Examination of Drawings:
1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc. , and the approximate sizes of equipment.
 2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of electrical raceways so as to best fit the layout of the job.
 3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
 4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where such items are required by other sections of the specifications or where they are required for proper installation of the work, such items shall be furnished and installed.
 6. If an item is either shown on the drawings or called for in the specifications, it shall be considered sufficient for including same in this contract.
 7. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
 8. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and connect complete and ready for operation, the items mentioned.
- F. Field Measurements:
1. Before ordering any conduit, conductors, wireways, bus duct, fittings, etc., This Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.05 SUBMITTALS

- A. In addition to the provisions of Division 1, the following is required:
1. Submittals shall include all fabrication, erection layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
 2. The Contractor shall submit electronic copies of each shop drawing for review by the Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.
 3. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all deviations from the contract documents on all submittals. IF DEVIATIONS ARE NOT MARKED BY THE CONTRACTOR, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.
 4. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 5. The Contractor shall clearly indicate the size, finish, material, etc.
 6. All submittals shall be assembled in sets such as luminaires, power distribution, fire alarm, generators, wiring devices, etc. All sets shall be identical.
 7. Each set shall contain an index of the items enclosed with a general topic description on the cover.

8. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is relevant to the work.
 9. Failure to comply with the above shall be reason to resubmit all shop drawing submittals.
 10. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals.
 11. See specifications for items required to be submitted.
- B. PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE
1. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
 2. Store materials on the site so as to prevent damage.

1.06 WARRANTY

- A. Provide one (1) year warranty for all fixtures, equipment, materials and workmanship.
- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of final written acceptance unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or his representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all Work and/or equipment found to be defective or nonconforming to the contract documents.
- D. THE CONTRACTOR SHALL BEAR THE COST OF CORRECTING ALL DAMAGE RESULTING FROM SUCH DEFECTS OR NONCONFORMANCE WITH CONTRACT DOCUMENTS EXCLUSIVE OF REPAIRS REQUIRED AS A RESULT OF IMPROPER MAINTENANCE OR OPERATION, OR OF NORMAL WEAR AS DETERMINED BY THE ARCHITECT/ENGINEER.

1.07 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.08 MATERIAL SUBSTITUTIONS

- A. Where several manufacturer's names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.
- B. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/ Engineer may reject manufacturer at time of shop drawing submittal.

1.09 MANUFACTURERS AND MODEL NUMBERS

- A. Where drawing schedules call out specific manufacturer's model numbers, the numbers are listed solely for the convenience of the contractor.
- B. Where specific manufacturer's model numbers are called out, the Contractor and Material Supplier are responsible for verifying the correct model number. Where scheduled capacities, options, or accessories conflict with model numbers specified, the greater capacity, options, or accessories shall be bid upon and supplied unless addressed by the Engineer prior to Bid date.
- C. Incorrect model numbers shall be brought to the attention of the Engineer when discovered.

1.10 RESOLUTION OF DISCREPANCIES

- A. If discrepancies are found to exist between the project drawings and project specifications, the more restrictive and obligatory document shall prevail as the project requirement.
- B. If discrepancies are found to exist between the requirements of the; Electrical Specifications, the Mechanical Specifications, the Architectural Specifications, and/or the Specification Front End Documents (Bidding Requirements-Agreement, Bonds, and Closeout Documents-Project Forms-Conditions of the Contract), the more restrictive and obligatory document/section(s) shall prevail as the project requirement.

PART 2 PRODUCTS

2.01 GENERAL

- A. All items of material having a similar function (i.e. safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers), shall be of the same manufacturer. This shall be adhered to unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 EXECUTION

3.01 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
 - 1. The Contractor shall do all necessary excavating, securing, filling, backfilling, compacting, and restoration in connection with his work.
- B. Excavation:
 - 1. Excavations for structures, manholes, pits and trenches shall be excavated to accurate, solid, undisturbed foundation beds required for foundations, slabs on grade, etc., and to proper dimensions to permit installation and inspection of forms and other work.
 - 2. Where excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Thoroughly compacted, clean, stable soil fill shall be placed in excess excavations under slabs on grade, all at the Contractor's expense.
 - 3. Bottom and sides of excavations shall be trimmed to required grade and lines to receive foundations.
 - 4. Excavations shall be protected against frost action and freezing.
 - 5. Care shall be exercised in excavating so as to not damage surrounding structures, equipment, and buried utilities. In no case shall any major structural footing or foundation

be undermined.

6. All trenching shall be performed in a manner to prevent cave-ins and risk to workmen.
 7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
 8. Excavation shall be performed in all ground characteristics, including rock, if encountered. Each bidder shall visit the premises and determine for himself, by actual observations, borings, or other means, the nature of the soil conditions. The cost of all such inspections, borings, etc. , shall be borne by the bidder.
 9. In the case where the trench is excavated in rock, a compacted bed with a depth of 3 inches (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
 10. Where satisfactory bearing soil is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately and no further work shall be done until further instructions are given.
 11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements shall be permitted, unless otherwise indicated on the electrical drawings.
 12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed shall be permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed having a minimum depth of 3 inches.
- C. Dewatering:
1. The Contractor shall be responsible for the furnishing, installation, operation and removal of all dewatering pumps and lines necessary to keep the excavation free of water at all times.
- D. Underground Obstructions:
1. Known underground piping, conduit, feeders, foundations, or other underground obstructions in the vicinity of construction are noted on the drawings. The Contractor is responsible for reviewing all Bid Documents for all trades on the project to determine obstructions indicated. The Contractor shall use great care in making his installation in the vicinity of underground obstruction.
 2. If objects not shown on the drawings are encountered in area of new construction, remove, relocate, or perform extra work as directed by the Architect/Engineer.
- E. Fill and Backfilling:
1. No rubbish or waste material shall be permitted in excavations for trench fill and backfill.
 2. The Contractor shall provide the necessary sand for backfilling.
 3. Dispose of the excess excavated earth as directed.
 4. Soils for backfill shall be suitable for required stability and compaction, clean and free from perishable materials and free from stones greater than 4 inches in diameter. Under no circumstances shall water be permitted to rise in unbackfilled trenches after installation has been placed. No material shall be used for backfilling which contains stones having any dimension greater than 4 inches, frozen earth, debris or earth with an exceptionally high

void content.

5. All trenches and excavations shall be backfilled immediately after installation of conduit, or removal of forms, unless other protection is directed.
6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch thick uniform horizontal layers with each layer being compacted separately to required density.
7. All conduit shall be laid on a compacted bed of sand at least 3 inches deep. Backfilling around the conduit with sand, spread in 6 inch layers and compact each layer.
8. Use sand for backfill up to grade for all conduit located under building slabs or paved areas. All other conduit shall have sand backfill to 6 inches above the top of the conduit.
9. The backfilling above the sand shall be placed in uniform layers not exceeding 6 inches in depth. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral or vertical displacement.
10. Where the fill and backfilling will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
11. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition at completion of the work. All planting and landscaping features removed or damaged during the course of the work shall be replaced to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out on the drawings or I in the specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged during the course of the work shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.02 FIELD QUALITY CONTROL

A. General:

1. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
2. The necessary instruments, meters, etc., required to conduct or make the tests shall be supplied by the Contractor who shall also supply a competent technician for making the tests who has been schooled in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Shorted or grounded wires and cables shall be removed and replaced.
 4. All electrical installations shall be completed in a neat and workmanlike manner, electrical installations shall not be completed in a manner that would prevent future installation of electrical conduit, panels, or devices.
 5. Each circuit installed by Contractor over 100 feet in length shall have the most distant outlet or load tested for voltage drop under full load conditions. Full load for outlet(s) shall be determined by multiplying the upstream overcurrent device by 80 percent and applying the calculated load to the most distant location of the circuit. Full load for equipment shall be equipment operating at full output. The Contractor shall increase wire size of circuit until voltage drop is below 3% of rated voltage. The Contractor shall provide a load bank to perform tests.
 6. Any wiring device, electrical apparatus or lighting fixture furnished under this contract, if grounded or shorted on any integral "live" part, shall be removed and the trouble rectified by replacing all defective parts or materials as directed.
 7. Cable insulation shall be tested for proper insulation values. Such tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free from short circuits and grounds and have an insulation value not less than the National Electrical Code Standards. Readings shall be taken between conductors and between conductors and ground.
 8. A record of readings taken shall be supplied to the Architect/Engineer in a neat and understandable form and in triplicate. The record shall include: circuit designation, ampere loading, voltage at circuit overcurrent device, and voltage at circuits extremity under full load as calculated in previous paragraph.
 9. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/ Engineer or code enforcing agency deems necessary.
- B. Low Voltage Cable (600 volts and below):
1. Test shall be made by means of an insulation testing device such as a "Megger" using not less than 500 volts D.C. test potential.
- C. Ground Resistance:
1. Service ground resistance tests shall be conducted using an approved manufactured ground resistance measuring meter. The Contractor shall submit to the Architect /Engineer for approval a test procedure he proposes to use including type of equipment to be used. (Note that the conventional ohmmeter is not an acceptable device.)
 2. Ground resistance measurements shall be made during normal dry weather and not less than 48 hours after a rain. Ground resistance values shall be verified by the Architect /Engineer at the time the readings are taken.

D. Other Equipment:

1. Other equipment furnished and installed by the Contractor shall be given all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, etc., voltage complies with equipment nameplate rating and full load amperes are within equipment rating.
2. In the event the results obtained in the tests are not satisfactory, the Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

3.03 PROJECT CLOSEOUT

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Before final payment will be authorized, This Contractor must have completed the following:
 1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
 2. Submitted bound copies of approved shop drawings.
 3. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
 4. Submitted inspection and testing report by the fire alarm system manufacturer.
 5. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

3.04 OPERATION AND MAINTENANCE MANUAL

- A. As part of instructing the Owner, This Contractor shall assemble, organize, and bind operation and maintenance manuals on the electrical systems installed.
- B. Submit three (3) properly indexed and bound copies of the manual to the Architect/Engineer for approval. Make all corrections or additions required. Prepare an electronic copy in Portable Document Format (PSF) on electronic media.
- C. Operation and Maintenance Manuals shall consist of the following:
 1. Title page with project title, Architect, Engineer, and Contractor, with addresses, telephone numbers, and contacts.
 2. Table of Contents describing index.
 3. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers, and contacts.
 4. Index tabs dividing information by specification section, major equipment, or systems.
- D. Operation and Maintenance Data on Equipment or Systems shall include:
 1. Schematic wiring diagrams of the equipment which have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 2. Dimensional drawings of equipment.

3. Detailed parts list with list of suppliers.
4. Operating procedures for each system.
5. Maintenance schedule and procedures. Include maintenance chart that lists routine maintenance requirements and frequency over one year time period.
6. Repair procedures for major components.
7. Replacement parts and service material requirements for each system and the frequency of service required.
8. Instruction books, cards, and manuals furnished with the equipment.

3.05 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to video tape the instructions to the Owner. Coordinate schedule of instructions to facilitate this recording.
- D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that either he or his representative can be present if desirable.
- E. Minimum manhours of instruction time for each item and/or system shall be as follows:
 1. Distribution System - 1/2 Hour.
 2. Lighting Systems - 1/2 Hour.
 3. Balance of Project - 1/2 Hour.
- F. The Contractor is responsible for all instructions to the owner and/or his operating staff on the electrical and specialized systems. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, he shall include in his bid an adequate amount to hire the Engineer to perform these instructions.

3.06 SYSTEM COMMISSIONING

- A. The electrical systems included in the construction documents are to be complete and operating systems. The Architect /Engineer will make periodic job site observations during the construction period. The system start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, balancing of loads, trouble shooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period. Testing shall also include all interlocks, safety shut-downs, system operations, and alarms.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect /Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory

start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Architect/Engineer on a time and material basis for services rendered at the Architect /Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Architect /Engineer for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

- D. Provide written documentation of completion of all commissioning and start-up tasks to the Owner for review.

3.07 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions; Change Orders, actual equipment and materials used.
- C. This Electrical Contractor shall maintain at the job site a separate and complete set of electrical drawings upon which he shall clearly and permanently mark and note in complete detail any changes made to the location and arrangement of the electrical apparatus or made in the electrical system and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer.
- D. Such record of changes shall be made daily by This Contractor and the marked drawings shall be available for the Architect and Engineer's examination at any normal work time.
- E. Upon completion of the job, and before final payment is made, This Contractor shall provide as built drawings to the Architect/Engineer.

3.08 PAINTING

- A. This Contractor shall paint any equipment which is marred or damaged prior to the Owner's acceptance and occupancy. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier when available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- B. Equipment located in finished areas and which will be painted to match the room decor will be painted by others. Should This Contractor install equipment in a finished area after the area has been painted by others, he shall be responsible for having the equipment and all of its supports, hangers, etc., painted to match the room decor at the Contractor's expense. Painting shall be performed as described in project specifications.
- C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish free from scratches, abrasions, chippings, etc.
- D. Equipment located in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. if color option is specified or color option given as standard to the unit, This Contractor shall, before ordering, verify with the

Architect /Engineer his color preference and shall furnish this color.

- E. This Contractor shall paint equipment located in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by him. If certain equipment is furnished with a factory coat of paint and enamel, it need not be painted, providing the factory applied finish is in no way marred or spattered and meets color requirements specified. If damaged, the item or piece of equipment shall be refinished with the same paint or enamel that was factory applied.
- F. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect/Engineer.
- G. Electric conduits shall NOT be painted in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location exposed threads at joints shall be given two coats of sealer after joint is made up.
- H. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, the raceway or equipment shall be painted with the following paint materials:
 - I. Bare Metal Surfaces -- Apply one coat of metal primer suitable for use on metal being painted. Finish with two coats of Alkyd base enamel paint.
 - J. Plastic Surfaces -- Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.
- K. Color of paint shall be as specified by Room Finish Schedule found on the architectural drawings, or as directed by the Architect.

3.09 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment and fixtures.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION 26 05 00

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Temps 2005 (Reapproved 2021).
- F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation 2018.
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- J. NECA 104 - Standard for Installing Aluminum Building Wire and Cable 2012.
- K. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- L. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- M. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

- O. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- P. UL 267 - Outline of Investigation for Wire-Pulling Compounds Current Edition, Including All Revisions.
- Q. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- R. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- S. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- T. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductor Material:
 - 1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
 - a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
 - 1) Services: Copper conductors size 1/0 AWG and larger.
 - 2) Feeders: Copper conductors size 1/0 AWG and larger.
 - b. Where aluminum conductors are substituted for copper, comply with the following:
 - 1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
 - 2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
 - 3) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
 - 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- I. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - 2. Control Circuits: 12 AWG.
- J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- K. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:

- 1) Phase A: Brown.
- 2) Phase B: Orange.
- 3) Phase C: Yellow.
- 4) Neutral/Grounded: Gray.

b. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 1. Copper Building Wire: Type THHN/THWN-2 or XHHW-2.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
 2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
Type XHHW-2.

2.04 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.

- 6. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 25 00 - Substitutions.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 25 00 - Substitutions.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.05 ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Substitutions: See Section 01 25 00 - Substitutions.
 - 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- D. Wire Pulling Lubricant:
 - 1. Listed and labeled as complying with UL 267.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Suitable for use at installation temperature.
- E. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install aluminum conductors in accordance with NECA 104.
- D. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- I. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- J. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 3. Wet Locations: Use heat shrink tubing.
- L. Insulate ends of spare conductors using vinyl insulating electrical tape.
- M. Identify conductors and cables in accordance with Section 26 05 53.
- N. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2022.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2023.
- E. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.

- b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
 - 3. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - 4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 - 5. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- F. Service-Supplied System Grounding:
 - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
 - 1. Provide grounding electrode system for each separate building or structure.
 - 2. Provide equipment grounding conductor routed with supply conductors.
 - 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 - 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- H. Separately Derived System Grounding:
 - 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - 2. Provide grounding electrode conductor to connect derived system grounded conductor to common grounding electrode conductor ground riser. Unless otherwise indicated, make

- connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
 4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
 6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal process piping.
- J. Lightning Protection Systems:
1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.

2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

K. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

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

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:

1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Rod Electrodes:

1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

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

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

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically.

Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 05 53.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
- D. MFMA-4 - Metal Framing Standards Publication 2004.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.

3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 2. Comply with MFMA-4.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

END OF SECTION 26 05 29

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Rigid polyvinyl chloride (PVC) conduit.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 31 23 16 - Excavation and Backfill for Pipes and Appurtenances: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
- E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- L. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
- M. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.
- N. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
- P. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.
- Q. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) or schedule 80 rigid PVC conduit where emerging from underground.
 - 4. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows for bends.
- D. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC).
- E. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- F. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
- G. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- H. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
 - 1. Corrosive locations include, but are not limited to:
 - a. Chemical storage areas [Ferric Room].
 - b. Wet wells, meter pits.
- I. Hazardous/Classified Locations: Use PVC-coated galvanized steel rigid metal conduit (RMC).
- J. Flexible Connections to Vibrating Equipment:
 - 1. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 2. Maximum Length: 6 feet unless otherwise indicated.

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Electrical Service Conduits: See Section 26 21 00 for additional requirements.
- C. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.
- D. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:

1. 3/4 inch (21 mm) trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 2. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 3. Material: Use steel or malleable iron.
 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

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

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
- C. PVC-Coated Boxes and Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 4. Material: Use steel or malleable iron.
 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.

2.06 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 80 unless otherwise indicated; rated for use with conductors rated 90 degrees C.

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

2.07 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- D. Conduit Mechanical Seals:
 - 1. Listed as complying with UL 514B.
 - 2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 - 3. Suitable for sealing around conductors/cables to be installed.
- E. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- E. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- F. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 4. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 5. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 - 6. Arrange conduit to provide no more than 150 feet between pull points.
 - 7. Route conduits above water and drain piping where possible.
 - 8. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 9. Group parallel conduits in same area on common rack.
- G. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 4. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 7. Secure joints and connections to provide mechanical strength and electrical continuity.
- I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
- J. Underground Installation:
1. Provide trenching and backfilling; see Section 31 23 16.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 36 inches.
- K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where conduits are subject to earth movement by settlement or frost.
- L. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. Where conduits may transport moisture to contact live parts.
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 36 inches at each end.
- N. Provide grounding and bonding; see Section 26 05 26.
- O. Identify conduits; see Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- G. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- H. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 25 00 - Substitutions, for additional provisions.
 - 2. Keys for Lockable Enclosures: Two of each different key.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 2. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 3. Use cast aluminum boxes where aluminum rigid metal conduit is used.
 4. Do not use "through-wall" boxes designed for access from both sides of wall.
 5. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 6. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
 - d. Substitutions: See Section 01 25 00 - Substitutions.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- E. Install boxes plumb and level.
- F. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- G. Install boxes as required to preserve insulation integrity.
- H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- I. Close unused box openings.
- J. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- K. Provide grounding and bonding in accordance with Section 26 05 26.

END OF SECTION 26 05 33.16

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.
- E. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.
- E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - 2. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

3. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
 4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 5. Use underground warning tape to identify direct buried cables.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Materials:
 - a. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.

5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.04 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
1. Tape for Buried Power Lines: Black text on red background.

2.05 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
1. Materials:
 - a. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Interior Components: Legible from the point of access.
 - 6. Conductors and Cables: Legible from the point of access.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.

END OF SECTION 26 05 53

SECTION 26 05 83
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices.
- E. Section 26 28 16.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.16.

2.02 EQUIPMENT CONNECTIONS

- A. Other Equipment:
 - 1. Electrical Connection: Flexible conduit.

PART 3 EXECUTION

3.01 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 26 05 83

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 26 05 33.16 - Boxes for Electrical Systems.

1.02 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification) 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.04 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

- A. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- B. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- C. Wiring Devices Installed in Wet or Damp Locations: Gray with specified weatherproof cover.

2.03 WALL SWITCHES

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw as indicated on the drawings.

2.04 RECEPTACLES

- A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- B. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
- C. GFCI Receptacles:
 - 1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - 2. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.05 WALL PLATES AND COVERS

- A. Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- B. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- C. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

END OF SECTION 26 27 26

SECTION 26 28 16.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- E. Substitutions: See Section 01 25 00 - Substitutions.

- F. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

- a. Provide means for locking handle in the ON position.
- O. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Identify enclosed switches in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.03 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.04 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 16.16

DIVISION 31 – EARTHWORK

SECTION 31 00 00

EARTHWORK

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PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Earthwork for construction of subgrade for paving, landscape grading and earthwork as shown on the Drawings and indicated in these Specifications.
 - 2. Consolidation and compaction.
 - 3. Unsuitable and excess cut material is to be spread or stockpiled per Owner's request at an on-site location.

- B. Related Sections:
 - 1. Section 01 10 00 – Summary of Work
 - 2. Section 01 40 00 – Quality Requirements
 - 3. Section 31 10 00 – Site Preparation
 - 4. Section 31 23 16 – Excavation
 - 5. Section 31 23 17 – Trenching
 - 6. Section 31 23 23 – Fill
 - 7. Section 32 11 00 – Aggregate Base and Surface
 - 8. Section 32 13 13 – Concrete Paving

1.2 DEFINITIONS

- A. Earth: All materials, not classified as rock, including clay, silt, sand, gravel, hardpan, disintegrated shale, debris, loose stones, boulders less than 3/4 CY in volume, trees, stumps, roots and rubbish.

- B. Rock: Solid mineral material with a volume in excess of 3/4 cubic yard or solid material that cannot be removed with heavy duty trench excavating equipment such as a CAT 350 Excavator equipped with a rock ripper bucket without drilling, jackhammering or blasting.

- C. Rubble: Buried concrete foundations, beams, walls and other material which require continuous use of pneumatic tools or blasting.
- D. Borrow: Materials in excess of excavated materials, needed to construct access drive embankments, parking lots and grading around buildings.
- E. Removal of rock, rubble and miscellaneous debris above ground is incidental to construction.

1.3 REFERENCES

- A. ANSI/ASTM C316 - Method for sieve analysis of fine and coarse aggregate.
- B. ANSI/ASTM D698 - Test method for Moisture Density Relationship of Soils and Soil-Aggregate Mixtures using 5.5 lb. Rammer and 12 inch drop.
- C. ASTM D2434-68 - Test Method for Permeability.
- D. Where reference is made to one of the above standards, the revision in effect at the time of the notice to proceed shall apply.

1.4 QUALITY ASSURANCE

- A. See Section 01 40 00.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 00.
- B. Test results: In-Place Density Tests.

1.6 JOB CONDITIONS

- A. Notify corporations, companies, individuals or authorities owning above or below ground conduit, wires, pipes or other utilities running to property or encountered during the work operations. Cap or remove and relocate services in accordance with instructions by owner of said services. Protect, support, and maintain utilities to remain in accordance with requirements of owners of said services.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Section 31 23 23 – Fill contains materials earthwork.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Maintain and protect existing utilities.

- C. Protect plant life, ground cover and other features remaining as a portion of the final landscaping. Areas disturbed outside construction limits indicated on plans will be shaped, graded and seeded at no additional cost to the Owner.
- D. Remove and replace fences and other structures indicated on plans.
- E. Protect benchmarks, grade stakes and other control stakes. Cost of restaking will be paid by the Contractor.
 - 1. Engineer will be paid by the Owner for costs associated with replacing benchmarks, grade stakes and control stakes destroyed by the contractor. These costs will be deducted from payments made by the Owner to the contractor.
- F. Clear entire surface of all areas to be excavated. Refer to Section 31 10 00 – Site Preparation.
 - 1. Remove all trees, stumps, down timber, logs, snags, brush, undergrowth hedges, heavy growth of grass or weeds, structures, debris and rubbish of any nature.
 - 2. Clear all areas on which embankments or fill is to be placed.
 - a. Comply with item 3.1, A.
 - b. Excavate a minimum of six (6) inches to remove roots and organic material.
 - c. Disk to a depth of six (6) inches.

3.2 SITE EARTHWORK AND GRADING

- A. The proposed grading plan shown on drawings may be constructed of material borrowed from excavations and the on-site or adjacent borrow area. The haul distance to perform fill operations shall be incidental to the price of excavation and no separate or additional payment will be awarded.
- B. Contractor shall adjust the in-place subgrade soil moisture content to within a range of +0% to +4% above the optimum moisture content and compact to minimum of 98% of the materials maximum dry density (ASTM D698) under structures. Compaction under road and parking areas shall be 95% (min).
- C. Excavated material suitable for backfill may be stockpiled on-site at designated locations.
- D. Prior to placing fill disc area minimum of 6 inches deep and compact with a minimum of 8 full coverage passes with compaction equipment approved by Engineer.
 - 1. Slopes steeper than 3:1 (horizontal to vertical) and more than 10 feet high: Bench prior to placing fill.
 - 2. Benches to be cut a maximum of 3-4 feet deep and have an approximate width of ten (10) feet.
- F. Place fill material in maximum 6 inch loose lifts, compact to specified maximum dry density as measured by Standard Proctor Test using sheepsfoot roller.
- G. Should moisture conditions become such that in the opinion of the Engineer, adequate compaction cannot be obtained, he may require that the operations be halted until moisture conditions have improved. Frozen materials shall not be used in the construction of the embankments. The fill shall not be placed on a frozen surface. If the operation in the construction of any section of the embankment has to be stopped during which rain is likely to occur, the surface shall be left in such a condition that it will provide drainage.

3.3 EXCAVATION

- A. Excavation shall be completed per Section 31 23 16, and as specified herein.
- B. Remove unsuitable material from excavated areas and prepare such areas for filling and backfilling as specified hereinafter.
- C. Excavated material suitable for backfill may be stockpiled on-site in location designated by Engineer, except place no fill where trenches or other services will be located.
- D. Place excavated soil not suitable for backfilling or site grading and materials containing slag, cinders, foundry sand, debris, and rubble in designated spoil areas and grade to drain.
- E. Prior to placing fill for site grading, disc area minimum of 6 inches deep and compact with a minimum of 8 full coverage passes with a sheepsfoot roller. Remove soft spots as directed by Engineer.
 - 1. Slopes steeper than 5:1 (horizontal to vertical): Bench prior to placing fill.
- F. Should moisture conditions become such that in the opinion of the Engineer adequate compaction cannot be obtained, Engineer may require that the operations be halted until moisture conditions have improved. Frozen materials shall not be used in the construction of the embankments. The fill shall not be placed on a frozen surface. If the operation in the construction of any section of the embankment has to be stopped during which rain is likely to occur, the surface shall be left in such a condition that it will provide drainage.

3.4 SUBGRADE CONSTRUCTION FOR PAVING (SPECIAL SUBGRADE COMPACTION)

- A. This specification applies to construction of subgrades under road paving, parking lots, driveways and other paved areas including:
 - 1. Crushed Stone Surfacing.
 - 2. Portland Cement Concrete Paving.
 - 3. Asphaltic Cement Paving.
- B. Shape and consolidate subgrade in preparation for placement of pavement or granular surfacing.
- C. Provide uniform composition at least 12" below top of subgrade for full width of subgrade plus two (2') feet on each side; scarify materials, mix and recompact, or otherwise treat to produce a uniform condition. Sequence of compaction is as follows:
 - 1. Grade to subgrade elevation.
 - 2. Remove top 6" of subgrade material and stockpile.
 - 3. Scarify, disk and recompact lower 6" of subgrade to 95% standard proctor density.
 - 4. Replace top 6" of subgrade and recompact to 95% standard proctor density.
- D. Remove stones over 2" in size from loosened portion of subgrade and dispose of as directed by Engineer.
- E. Construct subgrade with uniform density for a width equal to that of proposed drive plus 2' on each side; Density - not less than 95% maximum density.
- F. In areas where roller cannot compact, provide approved select material; 12" minimum thickness; compact to 95% maximum density with vibrating tamper.

- G. Construct to elevation and cross-section such that, after rolling, surface will be above required subgrade elevation.
- H. Perform proof rolling with a truck loaded to the maximum single legal axle gross weight of 20,000 pounds or the maximum tandem axle gross weight of 34,000 pounds. Operate trucks at less than 10 mph. Make multiple passes for every lane. The subgrade will be considered to be unstable if, under the operation of the loaded truck, the surface shows yielding (soil wave in front of the loaded tires) or rutting of more than 2 inches, measured from the top to the bottom of the rut at the outside edges
- I. Fill depressions that develop during rolling with suitable material; continue rolling until subgrade is uniformly firm, properly shaped and true to grade and cross-section.
 - 1. Maintain until pavement or granular surfacing is placed.
 - 2. Remove materials (other than sand) which will not compact readily under roller; replace with materials which will compact readily; again roll that portion of subgrade.
- J. If ruts or other objectionable irregularities form in subgrade during construction, reshape and re-roll subgrade before placing pavement or granular surfacing; fill ruts or other depressions with material similar to other subgrade material.
- K. Draw template, resting on side forms, over subgrade before pavement material is deposited.
 - 1. Use steel shod template, known as planner or scratch template with metal pegs set to proper subgrade elevation and spaced at intervals of 6" throughout its length.
 - 2. In irregular sections where use of template is impractical, check subgrade by most accurate practical method with approval of Engineer.

3.5 FINISH GRADING

- A. Examination:
 - 1. Verify fill material to be reused is acceptable.
 - 2. Verify building and trench backfilling has been inspected.
 - 3. Verify subsoil base has been contoured and compacted.
- B. Subsoil Preparation:
 - 1. Eliminate uneven areas and low spots.
 - 2. Remove debris, roots, branches and stones in excess of 1 inch in size. Remove subsoil contaminated with petroleum products.
 - 3. Scarify subgrade to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment is used for hauling and spreading topsoil and has compacted subsoil.
- C. Placing Topsoil:
 - 1. Place topsoil in areas disturbed by construction to a nominal depth of six inches.
 - 2. Use topsoil in relatively dry state. Place during dry weather.
 - 3. Fine grade topsoil eliminating rough or low areas. Maintain profiles and contour of subgrade.
 - 4. Remove roots, weeds and foreign material while spreading.
 - 5. Manually spread topsoil close to trees, plants and building to prevent damage.
 - 6. Lightly compact placed topsoil.
 - 7. Remove surplus subsoil and topsoil from site.
 - 8. Leave stockpile area and site clean and raked, ready to be seeded.
- D. Tolerances:

1. Top of Topsoil: Plus or minus 1 inch.
- E. Protection:
1. Protect landscaping and other features remaining as final work.
 2. Protect existing structures, fences, sidewalks, utilities, paving and curbs.
- F. Schedule:
1. Finish grading required on all surfaces not receiving paved surfaces.

End.

SECTION 31 10 00

SITE PREPARATION

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- 3.2 Stripping Topsoil.
- 3.3 Tree Removal.
- 3.4 Disposal of Spoil Material.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Clearing of surface debris.
 - 2. Excavating topsoil.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Disposal of spoil materials.
- B. Related Sections:
 - 1. Section 02 41 16 – Structure Demolition
 - 2. Section 31 00 00 – Earthwork

1.2 JOB CONDITIONS

- A. Notify corporations, companies, individuals or authorities owning utilities running to property or encountered during excavating operations.
- B. Cap or remove services in accordance with instructions by owners of services.
- C. Protect, support, and maintain utilities which are to remain.
- D. Replace to original condition or better, landscape work such as trees, shrubs, and grass within and outside of construction and grading limits that are damaged.

1.3 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures contains requirements for submittals.
- B. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

1.4 QUALITY ASSURANCE

- A. Conform to applicable codes for environmental requirements, disposal of debris, and use of herbicides.
- B. Perform work in accordance with State of Iowa and Bloomfield Township codes.

PART 2 – PRODUCTS - (Not Used)

PART 3 – EXECUTION

3.1 CLEARING AND GRUBBING

- A. Clear and grub area within limits to be covered with tanks, buildings, walks, parking areas, drives, and where grade to be raised of shrubs, trees, stumps, vegetation, rubbish, and other perishable or objectionable matter. Grub stumps.
- B. Remove trees and shrubs where specifically called for on the Drawings.
- C. Remove cleared material from site.

3.2 STRIPPING TOPSOIL

- A. Remove topsoil to entire depth in areas where grade is to be raised and in areas to be covered by structure, walk, or paving. Stockpile where designated by Engineer. Stockpile for proper drainage.
- B. Strip stockpile areas of vegetation prior to stockpiling.
- C. Stripped topsoil shall be free from clay, stones, excessive vegetation, and debris.
- D. Use for finish grading.

3.3 TREE REMOVAL

- A. Obtain authorization from Engineer prior to removing any trees except as indicated on Drawings.
- B. Removal includes grubbing and removing stump and roots and disposal of trees and debris.

3.4 DISPOSAL OF SPOIL MATERIAL

- A. Contractor is responsible for disposal methods and compliance with all Federal, State, County and City laws, ordinances and regulations.
- B. Contractor is responsible for obtaining all permits necessary for disposal.
- C. Disposal of spoil material may be by one of the following methods:
 - 1. Removal and disposal:
 - a. Promptly remove cleared debris from site. Burning of debris on-site is not permitted.
 - b. Disposal site will be arranged by Contractor subject to approval by Owner.

2. On-site volume reduction:
 - a. Promptly dispose of removed debris by cutting, chipping and grinding trees or other vegetative matter.
 - b. Log chipper must have capacity to chop logs removed and is subject to approval by Engineer. Chopper must be capable of chopping logs into chips no larger than 2-inches by 2-inches, 1/2-inch thick.
 - c. Chips will be hauled off site for final disposal.

End.

SECTION 31 23 16

EXCAVATION

INDEX

PART 1 – GENERAL

- 1.1 Summary.
- 1.2 Submittals.
- 1.3 Quality Assurance.
- 1.4 Job Conditions.
- 1.5 Underground Obstructions.
- 1.6 Protection of Persons and Property.

PART 2 – MATERIALS

- 2.1 Fill Materials.

PART 3 – EXECUTION

- 3.1 Inspection
- 3.2 Preparation
- 3.3 Excavation
- 3.4 Placing Fill

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation for site structures.
 - 2. Excavation for slab on grade paving, landscaping, and driveways.
 - 3. Excavation for building foundations.
- B. Related Sections:
 - 1. Section 01 10 00 – Summary of Work.
 - 2. Section 01 40 00 – Quality Requirements
 - 3. Section 31 00 00 – Earthwork.
 - 4. Section 31 23 17 – Trenching.
 - 5. Section 31 23 23 – Fill.

1.2 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures contains requirements for submittals.
- B. Test reports or samples of all fill materials.
- C. Laboratory compaction test reports.
- D. Field in-situ compaction test reports.
- E. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculation to support plan.

1.3 QUALITY ASSURANCE

- A. Testing shall be provided by Owner in accordance with Section 01 45 00 and this Section. Test 1 moisture / density relationship (ANSI/ASTM D698) for each source of soil encountered.

1.4 JOB CONDITIONS

- A. Notify corporations, companies, individuals or authorities owning above or below ground conduits, wires, pipes or other utilities running to property or encountered during excavating operations. Cap or remove and relocate services in accordance with instructions by owners of said services. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of said services.
- B. Do not block or obstruct roads, with excavated materials, except as authorized by Engineer. Trim banks to minimize inconvenience to public travel or to tenants occupying adjoining property.
- C. Sheeting, bracing, and shoring:
 - 1. Whenever necessary to prevent caving during excavation and protect adjacent structures, property, workers, and public; excavations shall be adequately sheeted, braced, and shored.
 - 2. Sheeting, shoring, bracing shall conform to safety requirements of federal, state, or local public agency having jurisdiction over such matters. Most stringent of these requirements shall apply.
 - 3. Sheeting, shoring, and bracing shall not affect structural integrity of new construction, water tightness and/or waterproofing of new construction, and shall allow for sufficient clearances necessary to install associated appurtenance adjacent to new construction. Sheeting, shoring, and bracing, shall not penetrate walls or slabs of new construction unless approved by Engineer.
 - 4. When close sheeting is required, drive to prevent soil from entering excavation either below or through sheeting.
 - 5. Sheeting shall be kept in place until structure has been placed, testing has taken place, and structure has been backfilled.
 - 6. Sheeting, bracing, and shoring shall be removed in manner that will not damage structure or permit voids within backfill.
 - 7. Fill settled areas remaining after sheeting have been pulled with sand or other approved material.
 - 8. Type, design, detailing, and installation of shoring, sheeting, and bracing shall be determined by and shall be sole responsibility of Contractor.

1.5 UNDERGROUND OBSTRUCTIONS

- A. Known underground piping, foundations, and other obstructions in the vicinity of new construction are shown on the Drawings.
- B. Protect underground facilities encountered during excavation until it is determined whether they are active or inactive. Repair, without compensation, existing active facilities damaged during operations.
- C. Notify Engineer of unexpected subsurface conditions and discontinue Work in area until Engineer provides directive and notification to resume work.

1.6 PROTECTION OF PERSONS AND PROPERTY

- A. Protect from damage existing buildings, walks, paving, fencing, sod, and other items noted to remain.
- B. Maintain benchmark, monuments, property stakes and other reference points.
- C. Protect existing underground utilities to remain:
 - 1. Notify the Engineer of underground utilities or structures encountered but not indicated on Drawings.
 - 2. Contractor responsibilities: Correcting damage caused to existing construction, utilities, surfacing, and other items noted to remain at no additional expense to the Owner.
- D. Barricade open excavations occurring as part of this work and provide warning lights.
- E. Provide temporary erosion control.

PART 2 – PRODUCTS

2.1 FILL MATERIALS

- A. Section 31 23 23 – Fill contains materials for fill and backfill.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Proof roll and examine surfaces to receive fill and subgrades within influence zone to determine existence of soft areas, areas loosened by frost action or softened by flooding or weather or of unsuitable materials.
- B. Complete bearing capacity and density tests defined in Section 01 40 00.

3.2 PREPARATION

- A. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.
- B. Remove and replace or compact natural soils or compacted fill softened by frost, flooding, or weather, as required by Engineer.
- C. Remove frozen soils within influence zone and replace with structural fill.
- D. Scarify top 6 to 8 inches of natural subgrade and compact to minimum density noted herein.
- E. Ninety-eight (98) percent Standard Proctor under footings, tanks and floor slabs. Where shale is encountered at final excavation depth, do not scarify. Protect shale from desiccation by placing Type 'A' fill as soon as practical after completion of excavation.

3.3 EXCAVATION

- A. Excavate to elevations and dimensions necessary to complete construction. If excavation is carried below bottom of foundations except as shown on plans, fill with concrete at no expense to Owner; see Section 03 30 00 for fill concrete requirements.
- B. Provide sheeting, shoring and bracing where required to hold walls of excavation, to protect structures or utilities or to provide safety for workmen.
- C. When quicksand, soft, spongy or otherwise unstable material is encountered which will not, in Engineer's opinion, provide suitable foundation for structure, Engineer will authorize in writing and direct removal and replacement with granular material; authorized over-excavation and backfill will be paid for as Extra Work.
- D. Do not excavate for other structures until scheduled for construction.
- E. Upon completion of excavation, notify Engineer before proceeding with further work.
- F. Protect excavated areas from freezing.
- G. Contractor shall be responsible for disposal of excess materials. All work associated with disposal of excess fill materials is incidental to the project.

3.4 PLACING FILL

- A. Notify Engineer before placing fill material.
- B. Do not use frozen material or place fill on frozen subgrade.
- C. Place filter fabric where shown on drawings in accordance with manufacturer's recommendations.
- D. Fill excavations below bottom of foundation or footing elevations within influence zone with concrete or structural fill.
- E. Do not backfill until new concrete has properly cured and required tests have been accepted.
- F. Place fill simultaneously on both sides of freestanding structures.
- G. Place fill against foundation walls enclosing interior spaces only after construction is in place to brace to walls.
- H. To minimize lateral forces against structure due to wedging action of soil, begin compaction of each layer at structure wall.
- I. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials.

End.

SECTION 31 23 17

TRENCHING

INDEX

PART 1 – GENERAL

- 1.1 Summary.
- 1.2 General Requirements.
- 1.3 Existing Utilities.

PART 2 – PRODUCTS

- 2.1 Pipe Envelope.
- 2.2 Remaining Backfill.
- 2.3 Backfill for Manholes, Appurtenances, and Structures.
- 2.4 Sidewalk and Pavement Materials.

PART 3 – EXECUTION

- 3.1 Examination.
- 3.2 Preparation.
- 3.3 Trench Construction.
- 3.4 General.
- 3.5 Sheeting, Shoring, and Bracing.
- 3.6 Dewatering.
- 3.7 Sidewalk and Pavement Removal.
- 3.8 Repair of Existing Drain Tiles and Storm Sewers.
- 3.9 Restoration of Surfaces.
- 3.10 Sidewalk and Pavement Replacement.
- 3.11 Grassed Surface Restoration.
- 3.12 Cleanup.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe bedding requirements.
 - 2. Trench execution and backfill.
 - 3. Backfill for manholes, appurtenances and structures.
 - 4. Sheeting, shoring and bracing.
 - 5. Cleanup.
- B. Related Sections:
 - 1. Section 01 10 00 - Summary of Work.
 - 2. Section 01 40 00 - Quality Requirements
 - 3. Section 31 00 00 - Earthwork.
 - 4. Section 31 23 16 - Excavation.
 - 5. Section 31 23 23 - Fill.

1.2 GENERAL REQUIREMENTS

- A. Schedule Work to keep streets, sidewalks, and utilities in usable condition. Avoid property owner inconvenience insofar as practicable.

- B. Do not trespass on private property or outside the limits of construction. Maintain construction operations on existing right-of-way or easements provided by Owner.
- C. Contractor shall provide name(s) and telephone number of person(s) who have access to equipment and are authorized to make emergency repairs to Contractor's Work, such as to correct trench cave-ins, moving excavated material, and correct other problems during weekends and off-work hours, so access can be maintained for fire fighting equipment, and to maintain barricades for public safety.
- D. Disposal area(s):
 1. Remove brush, rubbish, spoil, excess excavated material, and material not suitable for backfill to off-site location of Contractor's choice.
 2. Remove waste material promptly as it is generated by construction operations. Do not permit to accumulate.

1.3 EXISTING UTILITIES

- A. Obtain from utility companies locations of buried utilities in the project areas.
- B. Repair existing fences, and culverts, and drain tiles disturbed by construction.
- C. Contractor fully responsible for liaison with utility companies and for repairing, at no expense to Owner, utilities damaged by Contractor.
- D. In event of break in existing watermain, gas main, sewer, or electric or communication cable, immediately notify responsible official of organization operating utility affected.

PART 2 – PRODUCTS

2.1 PIPE ENVELOPE

- A. Applies to full trench width from bottom of trench to 1-foot above top of pipe for plastic pipe and other flexible pipe materials; to pipe centerline for ductile-iron pipe and other rigid pipe materials.
- B. Depth of material for pipe bedding shall be as shown on the Drawings.
- C. Bedding and initial backfill materials for ductile-iron and other rigid pipe material shall be Type 'A' material. Bedding and initial backfill materials for plastic pipe and other flexible pipe materials shall be Type 'A' crushed stone.

2.2 REMAINING BACKFILL

- A. Applies to backfill above 1-foot above top of pipe for plastic and other flexible pipe materials and above the centerline of the pipe for concrete and other rigid pipe materials.
- B. As soon as the condition of the pipe will permit, the entire width of the trench shall be backfilled. Earthen materials or aggregate shall be placed longitudinally along the pipe. Elevation of the haunching material on each side of the pipe shall be the same. Special care shall be taken to completely fill the space under the pipe haunches. Materials shall be placed in maximum 8-inch layers, loose measurement and compacted by ramming or tamping.
- C. Granular backfill material shall be Type 'A' crushed stone.

- D. Material for earthen backfill may be job-excavated material, free from debris, stones larger than 2-inches, organic matter, and frozen material.
- E. Where subgrade conditions warrant extra precautions for the bedding of rigid pipe, Engineer may order the construction of a concrete cradle to support the rigid pipe. Cradle shall be constructed as directed by the Engineer. Extra payment for concrete cradle may be made in accordance with the Contract Documents if not shown on the Drawings.
- F. Trenches shall be backfilled in accordance with the following methods, in accordance with the details on the Drawings:
1. **METHOD I** – This method applies to pipes under yards and unimproved areas. In this method, the trench shall be backfilled with excavated materials in a manner that will not dislodge or damage the pipe or cause bridging action in the trench. The material shall be deposited in uniform layers not exceeding 12-inches thick, loose measure. Each layer shall be compacted by ramming or tamping or, if directed by the Engineer shall be inundated or deposited with water. Pipes in these areas will generally not require water jetting unless the Engineer determines that early settlement is required. If jetting is used, it shall be considered incidental to piping installation and no additional compensation will be allowed. Top 6-inches shall be topsoil. Any rocks or clods greater than 2-inches in diameter shall be removed from the topsoil as it is spread. Top of the trench shall be left neatly rounded to allow for settlement.
 2. **METHOD II** – This method applies to alleys or parking areas that do not have permanent surfaces or oil and chip surfaces. In this case, the trench from the top of the granular pipe bedding to 6-inches below the ground surface shall be backfilled with granular backfill materials. The granular material shall be deposited in uniform layers not exceeding 6-inches thick, loose measure, and each layer shall be compacted by ramming or tamping. 6-inches of surface course aggregate shall be applied so that the finished surface of the aggregate is at the proposed surface elevation or matches the existing surface elevation. Material for surface course aggregate shall be crushed limestone.
 3. **METHOD III** – This method applies to all pipes buried beneath existing utilities or structures. In this case, the trench from the top of the granular pipe bedding to at least 6-inches above the existing utility or structure shall be backfilled with granular backfill. The granular material shall be deposited in uniform layers not exceeding 8-inches thick, loose measure, and each layer shall be compacted by ramming or tamping. Trench from 6-inches above the existing utility or structure to the surface shall then be backfilled in accordance with another applicable method; I, II or IV.
 4. **METHOD IV** – This method applies to any area where the existing or new surface is Portland cement concrete or bituminous concrete. In this case, the trench from the top of the granular pipe bedding to the bottom of the existing or new surface shall be backfilled with granular backfill. Granular material shall be deposited in uniform layers not exceeding 6-inches thick, loose measure, and each layer shall be compacted by ramming or tamping.
 5. **METHOD V** – This method applies to pipes buried beneath areas with oil and chip surfaces. Trench from the top of the pipe bedding to 12-inches below the surface shall be backfilled with granular backfill. Next 8-inches of the trench shall be granular subbase material per Specification Section 02511, paragraph 2.1.B. Final 4-inches of the trench shall be a combination of HMA base course and HMA surface course (with a total thickness of 4-inches) with tack coat.
 6. **METHOD VI**– This method applies to pipes beneath cultivated fields. Backfill shall be placed as in METHOD I, except no excavated material shall be allowed within the upper zone originally occupied by topsoil. After the backfill reaches the approximately lower limit of the original topsoil zone, the stockpiled topsoil shall

be spread in such a manner that natural settlement will not result in a depression along the pipeline. All rocks and boulders greater than 2-inches in diameter shall be removed from the topsoil as it is spread. Sufficient care shall be taken to prevent the inclusion of any material in the topsoil which would be considered unsuitable to agricultural purposes or deemed as a hazard to agricultural equipment. All manholes to be located within this area and indicated on the Drawings to be buried shall have the top of the frame and lid at least 18-inches below the finished ground elevation.

7. **METHOD VII** – This method applies to pipes buried within earthen berms. From the top of the pipe bedding to 12-inches below the proposed finish grade, trench shall be backfilled with select excavated material (compacted to 90 percent standard proctor) placed in 8-inch layers. Top 12-inches shall be filled with topsoil.

G. Water jetting backfill:

1. Where water jetting is called for, all trench backfill shall be compacted by jetting and water soaking in the manner described below. Trench compaction shall be started at the point of lowest elevation of the trench and work up along the trench. Jetting and water soaking shall not begin until the trench has been backfilled to within 6-inches of the finished surface.
2. Holes through which water is injected into the backfill shall be centered over the trench backfill and at longitudinal intervals of not more than 6-feet. Additional holes shall be provided if deemed necessary by the Engineer to secure adequate settlement. All holes shall be jetted and shall be carried to a point 1-foot above the top of the pipe. Drilling the holes by means of augers or other mechanical means will not be permitted. Care shall be taken in jetting so to prevent direct contact with, or disturbances of the pipe. No more than 100-linear feet of completed sewer lines shall remain un-jetted at any one time.
3. Water shall be injected at a pressure and rate just sufficient to sink the holes at a moderate rate. After a hole has been jetted to the required depth, the water shall continue to be injected until it begins to overflow the surface. Contractor shall, at his own expense, bore test holes at such locations as the Engineer may designate in order to determine the effectiveness of the water soaking. A soil auger shall be used for boring test holes. As soon as the jetting and water soaking has been completed, all holes shall be filled with soil and compacted. Surface depressions resulting from backfill subsidence caused by jetting and water soaking shall be filled and re-compacted by tamping or rolling to the satisfaction of the Engineer.
4. Water shall be furnished at the Contractor's expense. Contractor shall conform to municipal ordinances, rules, or regulations concerning its use. Water jetting backfill shall be incidental to pipe line installations.

H. Where there is a deficiency of suitable backfill material due to a rejection of part or all of the excavated material as unsatisfactory for backfill purposes, Contractor shall furnish satisfactory backfill material wasted from trench excavation in other locations or from other sources furnished by the Contractor. Backfill furnished and disposal of unsatisfactory material under these circumstances shall be incidental to piping installation.

I. Backfilling shall proceed so that not more than 100-foot intervals between the end of the backfilled section and the end of the laid pipe. No backfill material shall be placed until the Engineer has examined the grade of the pipe.

J. Where the trenches have been sheeted or braced, care must be taken in removing the same to keep the filling well above the lower ends of the sheeting or bracing so as to

prevent caving of the sides of the trench down onto the pipe and displacing them or damaging structures along the sides of the trench.

- K. Where the trench excavation is within the public right-of-way, or within 5-feet of a roadway, sidewalk, driveway, or wherever indicated on the Drawings, the trench backfill shall be tamped continuously to the surface with a mechanical tamper of a type approved by the Engineer. All material shall be compacted to 95 percent of the Standard Proctor Density as determined by ASTM D1557. No layer of material being compacted shall exceed 1-foot in depth. Engineer may perform density tests after tamping is complete on any layer.
- L. Where un-compacted backfill is indicated on the Drawings, the backfill material from the top of the granular backfill to the surface may be simply pushed into the trench and run over with the backfilling equipment.

2.3 BACKFILL FOR MANHOLES, APPURTENANCES, AND STRUCTURES

- A. Backfill material as required for adjacent trench.

2.4 SIDEWALK AND PAVEMENT MATERIALS

- A. Concrete pavement, and all types of concrete base pavement, may be cut only where, in the manner and to the extent specified herein, or authorized by the Engineer. Cuts shall be no larger than necessary to provide adequate working space for proper installation of pipe and pipeline appurtenances. A concrete saw shall be used for the cutting of concrete pavements along each side of trenches and at structures. All cuts shall be a minimum of 2-inches deep or $\frac{1}{4}$ the depth of the pavement, whichever is greater. All cuts in pavement shall begin and end at existing joints.
- B. Concrete pavements over trenches excavated for pipelines shall be removed to a width not less than 24-inches wider than the width of the trench at pavement subgrade. Trench width at pavement subgrade shall not exceed the minimum dimension that will allow good and safe construction except that no under cutting will be permitted. Shoulder not less than 12-inches in width, at any point, shall be left between the cut edge of the pavement and top edge of the trench. Pavement cuts shall be made to and between straight lines that, unless otherwise required, shall be parallel to the centerline of the trench.
- C. Where the line of the trench parallels the length of concrete walks and the trench location is all or partially under the walk, then the entire walk shall be removed and replaced. If necessary to remove concrete curbs, gutters, or walks, they shall be replaced to the existing joints.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify with testing laboratory fill materials to be reused is acceptable.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Maintain and protect existing utilities remaining, which pass through work area.
- C. Protect plant life, lawns and other features remaining as a portion of final landscaping.

- D. Protect benchmarks, existing structures, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- E. Cut out soft areas of subgrade not capable of insitu compaction.

3.3 TRENCH CONSTRUCTION

- A. Widths: Trenches shall be excavated to limiting trench widths and pipe clearances to provide adequate working space and clearances for proper pipe installation, jointing, and embedment operation. Also, for the protection of the pipe from external loads, limits to the maximum width of the lower portion of the trench below an elevation 6-inches above the top of the installation pipe shall apply. Such limiting minimum and maximum trench widths together with the minimum permissible clearance between the installed pipe and either trench wall shall be as follows:

Minimum and Maximum Trench Widths*			
Pipe Size, Inches	Minimum Width, Inches	Minimum Sidewall Clearance, Inches	Maximum Width, Inches
6	20	5	30
8	20	5	30
10	23	5	30
12	26	6	30
15	29	6	33
18	32	6	44
24	44	7	56

*Measured 6-inches above top of pipe

- B. Tunneling and boring: All excavation shall be done in open trenches except where tunneling or boring is shown on the Drawings or where written consent is given by the Engineer to tunnel or bore.
- C. Open trench in advance of Work: Not more than 100-feet of trench shall be opened up in advance of the completed piping or conduit work.
- D. Barricading work: Contractor shall provide and maintain the fences, walks, and bridges that are necessary for the public safety and convenience. Contractor shall place sufficient lights on or near the work and keep them burning from sunset to sunrise to ensure the safety of the public. Contractor shall keep watchmen on the work whenever the Engineer deems it necessary. Material delivered to the job shall be placed with minimal interference to traffic.
- E. Bell holes shall be carefully excavated at proper intervals so that the bells support no part of the load. No more shall be excavated than necessary to ensure the making of good joints.
- F. Sheet piling and bracing: In limiting trench widths, proper trench wall protection shall be used in accordance with OSHA Standards. If proper trench wall protection is not used, OSHA specified wall slopes shall be required for each type of soil. If wall protection is used, the sides of the trench shall be properly secured and supported by bracing and sheet piling according to approved sheeting methods. Sheet piling shall not extend below the top of the pipe. Bracing, sheeting, and shoring will not be considered an extra. Contractor shall sling, shore up, and secure in place all present sewers, water lines, conduits, and structures of a similar nature that are encountered in or near the trenches.

Contractor at his expense shall restore any such structure or conduit damaged by the excavation to its original condition.

- G. No explosives are to be used.
- H. Whenever work is to proceed over private property or other than the traveled way of streets or alleys, the topsoil shall be removed to a depth as directed by the Engineer up to a maximum of 1-foot. Such topsoil shall be stockpiled separately until backfilling operations are completed and then spread in a uniform layer, a minimum of 6-inches thick, over the area disturbed by the work.

3.4 GENERAL

- A. Trenches not requiring select backfill: Pile excavated material, suitable for backfill, in an orderly manner a sufficient distance back from edge of excavation to avoid slides or cave-ins (2-foot minimum clear distance).
- B. Trenches requiring granular backfill: Place unsuitable excavated material directly on trucks and haul away. No spoil banks permitted.
- C. If granular material suitable for trench backfill is encountered in trenches requiring trench backfill: Pile in an orderly manner a sufficient distance back from edge of excavation to avoid slides or cave-ins (2-foot minimum clear distance).
- D. Excavate existing utilities sufficiently in advance of pipe laying to determine crossing arrangement. No payment will be allowed for down time due to utility relocation.
- E. Excavation shall be open cut.
- F. Use caution when placing and compacting backfill to avoid placing construction loads on pipe that may damage or displace newly laid pipe.
- G. Support, brace or remove utility poles either adjacent to or in trench excavation.
- H. Utility mains shown on Drawings, in conflict with new facilities: Perform relocation or make arrangements with utility to perform Work at no additional cost to Owner.
- I. Utility mains not shown on Drawings, in conflict with trench excavation or new facilities:
 - 1. Notify Engineer and utility company immediately.
 - 2. Authorized relocation performed by Contractor or performed by others at Contractor's expense paid for under provisions of Article 11 of General Conditions.

3.5 SHEETING, SHORING, AND BRACING

- A. Construct sheeting, shoring, and bracing where shown on Drawings and where required to hold walls of excavation to protect existing utilities, trees, structures, and other similar features and to provide protection of employees.
- B. Design of sheeting, shoring, and bracing shall be responsibility of Contractor and shall comply with OSHA requirements.
- C. When movable trench shield is used below centerline of pipe, it shall never be lifted prior to any forward movement, to avoid the caving in of the bottom sides of the trench walls.

3.6 DEWATERING

- A. Execute Work in dry conditions.
- B. Provide equipment for handling water encountered.
- C. Do not lay pipe or pour concrete on excessively wet soil.
- D. Prevent surface water from flowing into excavation; promptly remove any water accumulated.
- E. Divert stream flow and/or sewage away from areas of construction.
- F. Do not discharge water pumped from excavations to existing sanitary sewers.
- G. Methods used shall not cause settlement or damage to adjacent property.

3.7 SIDEWALK AND PAVEMENT REMOVAL

- A. Where large portions of existing streets are removed, measure and record exact dimensions and elevations before pavement removal. Streets and curbs shall be rebuilt to same widths and elevations as existed prior to construction.
- B. Remove pavement, sidewalk, or curb and gutter to minimum of 1-foot from trench. No undercutting will be permitted.
- C. Saw cut vertically; remove on straight lines approximately parallel or perpendicular to centerline of pavement.
- D. Concrete and bituminous concrete and bituminous oil and chip pavement:
 - 1. Cut with concrete saw; minimum vertical cut 1-1/2-inch deep, as needed to give clean break.
 - 2. Break out remainder of slab.
- E. Sidewalk: Saw cut and remove to nearest joint beyond minimum distance of 1-foot from edge of trench.
- F. Dispose of waste material in disposal area.

3.8 REPAIR OF EXISTING DRAIN TILES AND STORM SEWERS

- A. Drain tiles and storm sewers broken during the trench excavation shall be repaired so their carrying capacities shall not be impaired. Broken drain tiles shall be replaced with larger sized piping, either corrugated metal pipe, PVC plastic pipe SDR-26, or ductile-iron pipe, as noted on the Drawings. Length of the pipe shall be such that it bears a minimum of 2-feet on undisturbed soil on each side of the piping trench, with each drain tile to pipe junction encased in concrete. All repairs of drain tile encountered shall be observed by the Engineer or Owner prior to backfilling. Compacted granular backfill will be required as of any existing utility or structure. Pipe to field tile junction shall be wrapped with burlap or other material prior to concrete encasement to prevent concrete from entering the flow line of the pipe.
- B. Drain tiles and storm sewers uncovered during the trench excavation which are laid parallel to the trench shall be protected and kept in service. Those tiles or storm sewers accidentally broken shall be repaired or replaced. If necessary they shall be re-routed around the improvements. Contractor shall receive additional compensation for replacing

the broken tiles or storm sewers if, as determined by the Engineer, the Contractor took adequate precautions against their damage.

3.9 RESTORATION OF SURFACES

- A. Restoration of surfaces shall include the removal of the existing surface, and disposal of surplus material, and the construction of new surfaces. Type of surface restored shall be equal to or better than the surface removed. Surfaces not removed during excavation but damaged by the Contractor's equipment or operation shall also be removed and replaced or repaired to original condition.
- B. Wherever conduits are constructed under traveled roadways, driveways, sidewalks, curbs and gutters, or other traveled surfaces, a temporary surface shall be placed over the top of the trench as soon as possible after compaction has been satisfactorily completed. Temporary surface shall consist of 12-inches of coarse aggregate, materials as specified for trench backfill (crushed limestone or washed gravel). Top of the temporary surface shall be smooth and meet the grade of the adjacent undisturbed surface. Temporary surface shall be maintained at the Contractor's expense until final restoration of the surface is performed as specified. No permanent restoration of surfaces shall be initiated until authorized by the Engineer. Temporary surfacing shall be required over the entire width of the trench, but any width in excess of the specified trench width shown on the Drawings shall not be used in computing payment quantities.
- C. Contractor shall restore all removed or damaged permanent pavements, sidewalks, driveways, curbs, gutters, fences, poles, and other property and surface structures removed or disturbed during or as a result of construction operations to a condition which is equal to or better than the appearance, quality and condition that existed before the work began. Restoration shall be made as soon as possible after compaction of the backfill has been completed.

3.10 SIDEWALK AND PAVEMENT REPLACEMENT

- A. Refer to Section 32 13 13 – Concrete Paving.

3.11 GRASSED SURFACE RESTORATION

- A. Refer to Section 32 92 19 - Seeding.

3.12 CLEANUP

- A. Contractor shall clean up as the Work proceeds. Premises shall be kept free of accumulations of waste materials and earth, rubbish and other debris resulting from the work. If in the judgment of the Engineer, the Contractor fails to keep the site clean as described herein above, Engineer will recommend to the Owner withholding all progress payment until the site has been cleaned up to the Engineer's satisfaction.
- B. All debris and waste materials and salvaged materials unless required by the Specifications to be reused or delivered to the Owner, shall become the property of the Contractor and shall be removed by the Contractor from the construction site.
- C. Any dirt, mud, or other debris tracked onto the adjacent streets by any of the Contractor's or supplier's vehicles shall be immediately cleared from the surface. Where truck crossings occur over sidewalks, that shall be kept from all spilled earth and grading materials and shall at all times be maintained in a passable condition for foot traffic.

- D. Generally, the transportation of materials to and from the job site shall be over regular streets. When the Contractor's operations or that of its shippers, haulers, or subcontractors are such that dirt, mud, or debris are spilled or otherwise deposited on streets, driveways, or sidewalks, the Contractor shall clean up any large chunks before the close of every day's operation or before it is broken up or becomes impacted on the surface. In case of dispute or Contractor's failure to perform the cleanup work, the Owner may clean the streets and walks, remove the rubbish, etc. and will charge the cost to the Contractor by withholding monies due to cover all charged work.
- E. At completion of the Work, Contractor will remove all waste materials, rubbish and debris from and about the premises as well as all tools, scaffolding and surplus materials, and will leave the site clean and ready for occupancy by the Owner. Contractor will restore to their original condition those portions of the site disturbed or damaged by the Contractor's operations.
- F. Open burning of debris will not be permitted unless specifically authorized in writing by the Owner, and then only following state, municipal or other local codes, ordinances, rules or regulations.
- G. Also see Section 01 70 00.

End.

SECTION 31 23 23

FILL

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- 1.2 Submittals.

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- 2.1 Coarse Aggregates.
- 2.2 Fine Aggregates.
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- 3.1 Examination
- 3.2 Preparation
- 3.3 Backfilling
- 3.4 Tolerances
- 3.5 Field Quality Control
- 3.6 Protection of Finished Work
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PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backfilling building perimeter to subgrade elevations.
 - 2. Backfilling site structures to subgrade elevations.
 - 3. Fill under footings and slabs.
 - 4. Fill under paving.
 - 5. Fill over-excavation.
- B. Related Sections:
 - 1. Section 01 40 00 – Quality Requirements.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 31 23 16 - Excavation.
 - 4. Section 31 23 17 - Trenching.
 - 5. Section 32 92 19 - Seeding.

1.2 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures contains requirements for submittals.
- B. Test reports or samples of all fill materials.
- C. Materials Source: submit name of fill materials suppliers.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

PART 2 – PRODUCTS

2.1 COARSE AGGREGATES

- A. Type A - Coarse Stone: Angular, limestone, washed or screened clean, free of shale, clay, friable material, sand, debris; graded in accordance with ANSI/ASTM C136 and IDOT D57, Section 4115, gradation number 3, within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch (25mm)	95-100
3/4 inch (19mm)	
1/2 inch (16mm)	25-60
3/8 inch (9mm)	
No. 4	0-10
No. 8	0-5
No. 200	0-1.5

- B. Type A2 – Modified Subbase; graded in accordance with IDOT Section 4123, gradation number 14, within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch (25mm)	100
3/4 inch (19mm)	
1/2 inch (16mm)	70-90
3/8 inch (9mm)	
No. 4	
No. 8	10-40
No. 200	3-10

- C. Type B:
1. Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136, to the following:
 - a. Minimum Size: 1/4 inch
 - b. Maximum Size: 5/8 inch
 2. 3/8 inch limestone chips: may be used in place of pea gravel if the following gradation is met:

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2 inch	100
3/8 inch	70 - 100
No. 4	10-30
No. 8	0 - 10
No. 30	0 -5
No. 200	0-1.5

2.2 FINE AGGREGATES

- A. Type C - Sand: Natural river or bank sand; washed: free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ANSI/ASTM C136, within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	100
No. 8	10 to 100
No. 100	4 to 30
No. 200	0 to 10

2.3 SUB SOILS

- A. Type D – Structural Fill: Approved site excavated material free of organic matter and debris, place in loose fill lifts not to exceed 8 inches in thickness and compacted to minimum standard proctor density as listed in paragraph 3.7, SCHEDULE.

2.4 BORROW MATERIALS

- A. Obtain borrow material from off-site source if volume of suitable excavation material is inadequate.
- B. Borrow materials shall conform to material specifications for intended use.

2.5 TOP SOILS

- A. Friable clay loam surface soil reasonable free of subsoil, clay lumps, stones and other objects over 2-inches in diameter and without weeds, roots and other objectionable materials.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify sub drainage, dampproofing, or waterproofing installation has been inspected.
- C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- D. Verify structural ability of unsupported walls to support loads imposed by fill

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Type 'A' fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify top 6 to 8 inches of natural subgrade and compact to minimum density noted herein.
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place fill material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth
 - 2. Structural Fill: Maximum 8 inches compacted depth

- 3. Granular Fill: Maximum 8 inches compacted depth
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
- G. Slope away from building minimum of 2 percent slope for minimum distance of 10-feet, unless noted otherwise.
- H. Make gradual grade changes. Blend slope into level areas.
- I. Remove surplus backfill materials from site.
- J. Leave fill material stockpile areas free of excess fill materials.

3.4 TOLERANCES

- A. Section 01 40 00 – Quality Requirements.
- B. Top surface of general backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Perform laboratory material and in place compaction tests in accordance with Section 01 40 00 – Quality Requirements.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.6 PROTECTION OF FINISHED WORK

- A. See Section 01 70 00 – Execution and Closeout Requirements.
- B. Reshape and re-compact fills subjected to vehicular traffic.

3.7 SCHEDULE

- A. Interior Slabs-On-Grade:
 - 1. Minimum of 6" or as indicated on the Drawings, Type 'A' fill to subgrade elevation compacted to 95% maximum in place density.
- B. Under Footings:
 - 1. Footings shall be founded on:
 - a. Undisturbed natural material where shown on plans, inspected by testing laboratory.
 - b. Type 'A' fill compacted to 95% of maximum in place density as shown on plans..
- C. Exterior Side of Walls:
 - 1. Type 'A', Type 'C', Type 'D' fill as shown on plans compacted to 98% Standard Proctor.
- D. Under exterior floors or exterior slab-on-grade: (sidewalks, concrete building entrance)

1. Type 'A' fill, 6 inches in thickness compacted to 95% maximum in place density.
- E. Exterior Paved Areas (driveways, parking areas):
1. Type 'A2' fill, thickness and compaction as indicated on drawings.
- F. Unpaved Exterior Areas:
1. Top six (6) inches black topsoil.
- G. Trenched Pipe Envelope:
1. Type 'A' fill compacted to 95% of maximum in place density.
 2. Fill remainder of trench as indicated on drawings.

End.

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 11 00

AGGREGATE BASE AND SURFACE COURSES

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PART 1 – GENERAL

- 1.1 Summary
- 1.2 Submittals

PART 2 – PRODUCTS

- 2.1 Materials

PART 3 – EXECUTION

- 3.1 Preparation
- 3.2 Equipment
- 3.3 Construction

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. This section consists of furnishing, hauling, placing, compacting, and shaping to obtain desired cross-section and profile for crushed stone base and surface course for parking areas and for crushed stone surfaced roadways and driveways.
 - 2. Term "IDOT Specifications" refers to Standard Specifications for Highway and Bridge Construction, most recent edition, Iowa Department of Transportation, including current revised and supplemental specifications.
- B. Related Sections:
 - 1. Section 01 40 00 – Quality Requirements
 - 2. Section 31 00 00 – Earthwork
 - 3. Section 31 10 00 – Site Preparation
 - 4. Section 31 23 16 – Excavation
 - 5. Section 31 23 17 – Trenching

1.2 SUBMITTALS

- A. Submit certification that aggregate source is approved by IDOT for material specified.
- B. Submit in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Aggregate for Crushed Stone Surfacing Surface Course: Meeting requirements of Section 4120.04 of IDOT Specifications (Class A Crushed Stone). Gradation must comply with Gradation No. 11 of Section 4109.

- B. Aggregate for Gravel Surfacing Base Course: Meeting requirements of Section 4115 of IDOT Specifications (Coarse Aggregate for Concrete). Gradation must comply with Gradation No. 4 of Section 4109. Minimum Durability is Class 2.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Subgrade preparation shall be in accordance with IDOT Specification 2109.05.

3.2 EQUIPMENT

- A. Weighing Equipment and Procedures: IDOT Specifications 2001.07.
- B. Compaction Equipment:
 - 1. Be of such design that operation shall not disturb subgrade or subbase.
 - 2. Types of equipment used shall be in accordance with IDOT Specification 2001.05, except that other types of equipment may be used provided it is demonstrated that they will consistently produce specified density and gradation.
 - 3. Compaction equipment known as sheep-foot rollers shall not be used to compact base or surface material.
- C. Equipment for Applying Water: IDOT Specification 2001.09.
- D. Prewetting Equipment: IDOT Specification 2001.08.
- E. Proportioning Equipment: When base material is composed of more than one aggregate, proportioning equipment shall include system of calibrated gates.
- F. Spreading Equipment: Capable of uniformly spreading base material to required thickness.
- G. Motor Patrols: IDOT Specification 2001.15.

3.3 CONSTRUCTION

- A. Construct crushed stone base on prepared subgrade or subbase in accordance with following requirements.
 - 1. Delivery of Base Material:
 - a. Pre-wet aggregate before delivery of aggregate to subbase.
 - b. Engineer may control rate of delivery of aggregate to reduce time aggregate will remain on subbase in uncompacted condition to practical minimum.
 - 2. Moisture Content:
 - a. At time base material is delivered to subbase, water shall be uniformly distributed throughout material so that all particles are uniformly wetted.
 - b. Amount of water shall be within 2.0 percentage points of amount determined as field optimum to produce maximum density, together with stability with field compaction procedure. Moisture content will usually be 85 to 90 percent of optimum determined according to 1.0.05 Laboratory Test Method 103.
 - c. Maintain moisture content in aggregate until compaction of base has been completed
 - 3. Spreading Aggregate:
 - a. Spread wetted base and surface material to width and depth that base will conform to desired profile and cross-section. Compacted thickness shall

- be a minimum 6 inches for base material and a minimum 6 inches for surface material with a total combined thickness of 12 inches.
- b. Maximum compacted thickness of material that may be spread for compaction as single course will be limited to that which will be uniformly and satisfactorily compacted for full depth of such course by compaction equipment employed.
 - c. Spread so that uniformity of base and surface material and its moisture content is maintained. When spreader does not spread to full design width in one operation, Engineer may require special handling of center joint to avoid segregation. Special handling may include motor patrol cut of joint after initial compaction, followed by spreading cut material in path of second spreading operation.
 - d. Contractor shall be responsible for obtaining designated thickness and for application rates. Any course determined to be deficient in thickness may be corrected by increased thickness of subsequent lift of course; however, thickness of course of 1/2 or 3/8 in. mixture size shall not be increased by more than 1/4 in. to correct deficiency.
4. Compaction:
- a. Promptly after material has been spread, thoroughly and uniformly compact to not less than 95 percent of maximum density described in Laboratory Test Method 103 (Standard Proctor Test).

End.

SECTION 32 13 13

CONCRETE PAVING

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- 1.4 Equipment Requirements

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- 2.3 Quality Control
- 2.4 Mixing

PART 3 – EXECUTION

- 3.1 Subgrade Preparation
- 3.2 Pavement Construction
- 3.3 Curing and Protection
- 3.4 Restrictions
- 3.5 Defects

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes the following:
 - 1. Construction of non-reinforced portland cement concrete pavement and sidewalks on prepared subgrade or subbase as shown on plans and specified herein.
 - 2. Non-reinforced portland cement pavement includes deformed tie bars and joints; see Standard Drawings.
 - 3. Thickness of portland cement concrete pavement as shown on plans.
- B. Related work specified elsewhere:
 - 1. Section 01 40 00: Quality Requirements.
 - 2. Section 03 30 00: Cast-in-Place Concrete.
 - 3. Section 31 00 00: Earthwork.
 - 4. Section 31 23 17: Trenching.

1.2 REFERENCES

- A. Iowa Department of Transportation (IDOT) Standard Specifications for Highway and Bridge Construction, most recent addition.

1.3 SUBMITTALS

- A. Refer to Specification Section 03 30 00 for concrete submittal requirements and tests.

1.4 EQUIPMENT REQUIREMENTS

- A. Batch or ready-mix plant: Shall comply with Iowa DOT standard specifications 2001.06, 2001.20 and 2001.21.

1. Automatic cut-off gates at cement batching scale required.
 2. Scales and measuring devices certified at Contractor's expense.
- B. Concrete mixing equipment: Shall comply with Iowa DOT standard specification 2001.21.
- C. Construction Equipment: Shall comply with Iowa DOT standard specification 2301.07.
- D. Alternate equipment and methods for finishing and consolidating pavement may be permitted by Engineer if satisfactory operation and construction on previous projects can be demonstrated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete shall be C4 mix, Type I (Portland Cement), 4,000 psi at 28 days, 3,000 psi at 7 days.
1. A Class 3 durability coarse aggregate shall be used.
 2. Entrained Air Content: 6.0% +/- 1.0%.
- B. Admixtures:
1. Air entraining: ASTM C260.
 2. Fly Ash: Type C, ASTM C618 and C494.
 3. Retarding: Shall comply with IDOT standard specification 4103.01.
 4. Calcium chloride may be used only with approval of Engineer.
 5. Other admixtures may be used subject to approval of Engineer in accordance with ASTM C494 or applicable standards.
- C. Fine Aggregate: Shall comply with I.D.O.T. Standard Specifications 4110.01, 4110.02, 4110.03 and 4110.04.
- D. Coarse Aggregate: Shall comply with I.D.O.T. Standard Specifications 4115.01, 4115.02, 4115.03, 4115.04 and 4115.05, Durability Class 3.
- E. Water: Clean and clear, free from salt, oil, acid, strong alkalis, vegetable matter, or other substances injurious to concrete; water may be heated for cold weather paving operations; anti-freezing agents not permitted.
- F. Reinforcing Steel: Shall comply with I.D.O.T. Standard Specification 4151.02.
- G. Metal expansion tubes: fabricated steel tubes; conform to requirements of IDOT; provide tubes with internal diameter 1/16" larger than dowel bar; bar stop capable of withstanding 20 lb. push, minimum.
- H. Metal keyways: fabricated 24 gauge sheet steel; conform to requirements of IDOT; provide lengths in multiples of tie bar spacing; punch to receive tie bars.
- I. Supports for reinforcing steel:
1. Support tie bars as required to place and maintain correct location during construction.
 2. Welded wire fabric supports: heavy gauge wire, welded or bent to form 4-legged chair; use only with permission of Engineer.
 3. Support dowel bars at expansion and contraction joints as shown on Standard Drawing.

- J. Joint Filler: Preformed expansion joint filler: asphalt saturated fiber strips; AASHTO M213; furnish in strips of plan dimensions.
- K. Concrete pavement joint sealer:
 - 1. Bituminous joint filler and sealer; hot poured joint filler: ASTM D3405; comply with IDOT 2301.25.
 - 2. Backer rope: cellulose, cotton or plastic foam suitable for use with hot-poured sealer; size and compression such that it maintains position during filling operation.
- L. Sidewalk joint sealer:
 - 1. Joint sealer: gray, one-component, non-priming, self-leveling, pour grade, polyurethane joint sealer; ASTM C920-79, Type S, Grade P, Class 25 or FS TT-5-00230C, Type 1, Class A; Sonolastic SL1, Vulkem 45 or approved equal. Use in sidewalk joints adjacent to buildings and curb and gutter.
- M. Liquid curing compound: IDOT 4105.05.
- N. Plastic film: Shall comply with I.D.O.T. Standard Specification 4106.02.
- O. Fly ash: meet requirements of IDOT Section 2301.04E and Section 4108, Class C; use source currently approved by IDOT; not acceptable for use after October 15 or prior to March 15.
- P. Burlap: AASHTO M182, Class 3.

2.2 STORAGE AND PROTECTION OF MATERIALS

- A. Fine Aggregates: Shall comply with IDOT standard specification 4110.
- B. Coarse Aggregates: Shall comply with IDOT standard specification 4115.
- C. Cement: Shall comply with IDOT Standard Specifications 4101 and 2301.13B.

2.3 QUALITY CONTROL

- A. Tests on trial batches and concrete placed at project site:
 - 1. Slump: Shall comply with IDOT Standard Specification 2301.04B.
 - 2. Air Entrainment: Shall comply with IDOT Standard Specification 2301.04C.
 - 3. Minimum compressive strength: ASTM C39; 3,000 psi when tested at 7 days and 4,000 psi when tested at 28 days.
 - 4. Quantity of compression cylinders as specified in Section 03300 - Cast-in-Place Concrete; cast, protect and cure cylinders in accordance with ASTM C31; all concrete testing performed by ACI certified field testing technician per ASTM C94, Section 14.
 - 5. Unit weight of fresh concrete.

2.4 MIXING

- A. Batch Mix: Shall comply with IDOT Standard Specification 2301.13.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Prepare subgrade or subbase as specified in Section 31 00 00 - Earthwork.

3.2 PAVEMENT CONSTRUCTION

- A. Setting and removing forms: Shall comply with IDOT Standard Specification 2301.09.
- B. Concrete and steel placement: Shall comply with IDOT Standard Specifications 2301.12 and 2301.14.
- C. Finishing: Shall comply with IDOT Standard Specification 2301.16.
- D. Construct joints as shown on Standard Drawings; seal as specified hereinafter.
 - 1. Round edges of concrete adjacent to header boards and expansion joint material to 1/8" radius.
 - 2. Shall comply with IDOT Standard Specification 2301.25.
- E. Seal all joints before pavement is opened to Contractor's forces or general traffic; seal only dry and clean joint surfaces; slightly under-fill joints, keep sealer off of adjacent pavement. Shall comply with IDOT Standard Specification 2301.25.
 - 1. Heat joint sealer to required temperature in thermostatically controlled heating kettle approved by Engineer; do not overheat.

3.3 CURING AND PROTECTION

- A. Apply liquid curing compound in fine spray to form continuous, uniform film on surface and vertical edges of pavement and curbs.
 - 1. Shall comply with IDOT Standard Specification 2301.19
- B. Concrete pavement less than 36 hours old shall be protected during cold weather as follows:
 - 1. Shall comply with IDOT Standard Specification 2301.19.
- C. Concrete damaged by excessive scaling, popouts, shrinkage cracks, rain or freezing shall be removed and replaced at Contractor's expense.

3.4 RESTRICTIONS

- A. Weather:
 - 1. Place no concrete when existing or forthcoming stormy or inclement weather prevents good workmanship, when subgrade is frozen or if air temperature is 38° F. or below and falling; use no aggregates containing frozen lumps.
 - 2. With favorable weather conditions, start paving operations when temperature of concrete delivered to subgrade is 40° F. or higher.
 - 3. Continue paving operations as long as concrete temperature requirement is met and air temperature remains above 38° F.
- B. Night Operation: Shall comply with IDOT Standard Specification 2301.30
- C. Use of pavement:
 - 1. Time for pavement for use will be determined by results of tests on cylinders taken during concrete placement.
 - 2. Pavement may be opened to Contractor's forces after 7 days for purpose of removing coverings and building shoulders if tests of cylinders from section show compressive strength of 3,000 psi or higher.
 - 3. Open pavement to general traffic when authorized by Engineer.
 - 4. Shall comply with IDOT Standard Specification 2301.31.
 - a. With exception that cylinders will be required in place of beams.

5. Concrete placed in cold weather may require additional curing time, as directed by Engineer; keep all vehicles off pavement until such curing time has been completed.

3.5 DEFECTS

- A. Pavement containing fractures, spalls, random cracks, significant popouts or shrinkage cracks, or other unacceptable defects: remove and replace at no cost to Owner; rout and seal all random cracks which develop prior to project completion.

End.

SECTION 32 92 19

SEEDING

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PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Certification of products.
- B. Acceptance and warranty.
- C. Seed types and mixes.
- D. Equipment.
- E. Application of seed.

1.2 DESCRIPTION OF WORK

- A. Specification includes materials, equipment, and labor requirements for the complete and satisfactory installation and maintenance for all seeding, including:
 - 1. Low maintenance mixture.

- B. Requirements for the Work on this Project are familiarity with the site, scope of Work of the Project, and coordination of the seeding with related Work.
- C. Seeding includes the operations of seedbed preparation, furnishing, applying, and covering the seed, and compaction of the seedbed.

1.3 SUBMITTALS

- A. Submit certification of products to the Engineer prior to seed placement:
 - 1. Seed: Submit a mechanically printed seed tag from an Iowa Crop Improvement Association-approved seed conditioner or grower. Submit a laboratory analysis for all seeds, specifying the purity and germination. Provide 48-hours notice prior to mixing the seed and give the Engineer an opportunity to witness the seed mixing.
 - 2. Fertilizer: Submit certification of the fertilizer analysis with scale weight and statement of guaranteed analysis. Submit from a certified fertilizer dealer, a mechanically printed commercial fertilizer label or bill of lading. All fertilizer will meet the inspection and acceptance requirements of Iowa DOT Materials I.M. 469.03.
 - 3. Wood cellulose fiber mulch: Submit certification of the degradable wood cellulose fiber mulch ingredients with applicable use and rate, and the water retention capacity by manufacturer or supplier.
 - 4. Wood excelsior mulch: Bale wood excelsior and determine the mass (weight). Use the mass of the material, furnished by the manufacturer, to determine the rate of application
 - 5. Straw mulch: Certify weight. Furnish a list of the number of bales and a corresponding ticket from an approved scale for the mulch material to be used on the project.
 - 6. Compost: Submit certification of composted organics analysis with U.S. Compost Council's Seal of Testing Assurance (STA), recommended rates of application, and manufacturer's estimated cubic yards per ton.
 - 7. Inoculant: Furnish information from inoculant packaging.
 - 8. Tackifier: Submit certification of the tackifier ingredients, recommended rates of application, and expiration date.
- B. When requested, submit written instructions recommending procedures for maintenance of seeded areas.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver packaged materials in original, unopened, and undamaged containers. Do not mix or blend materials except in the presence of the Engineer.
- B. Deliver, handle, and store all materials according to product recommendations, and protect from loss, damage, and deterioration.
- C. Materials not meeting these requirements will be rejected.

1.5 SCHEDULING AND CONFLICTS

- A. Coordinate the seeding schedule with all other Work on the Project. Notify the Engineer at least 3-calendar days prior to the start of seeding operations.
- B. Perform seeding operations an after all land-disturbing activity are completed, and after the seedbed has been approved by the Engineer.

PART 2 - PRODUCTS

2.1 SEED

- A. Provide fresh, clean, new crop, certified seed complying with tolerance for germination and purity and free of poa annua, bent grass, and noxious weed seed. Furnish all seeds, including grass, legume, forbs, and cereal crop seeds, from an established seed dealer or certified seed grower. All materials and suppliers are to follow Iowa Seed Law and Iowa Department of Agriculture and Land Stewardship regulations, and be labeled accordingly:
 - 1. Turfgrass will have a certified “blue tag.”
 - 2. Native grass and forbs that are source-identified as G0-Iowa certified yellow tag, when available.

- B. Mix seed to the specified proportions by weight by methods approved by the Engineer.

- C. Seed quality: Ensure the seed provided meets or exceeds the minimum requirements of purity and germination stated on an analysis document that specifies quality. Approval of all seed for use will be based on the accumulated total of Pure Live Seed (PLS) for each phase of work. PLS is obtained by multiplying purity times germination. PLS shall not be less than the accumulated total of the PLS specified. If the purity and/or germination of native grasses exceeds the minimum required, adjust the application rate based on PLS.

If the seed does not comply with minimum requirements for purity and germination and such seed cannot be obtained, the Engineer may approve use of the seed on a basis of PLS or may authorize a suitable substitution for the seed specified.

- D. Requirements on containers:
 - 1. Seed: Provide seed with a tag on each container. Seed analysis on the label shall be mechanically printed.
 - 2. Mulch: When packaged, provide mulch in new labeled containers.
 - 3. Tackifier: Provide tackifier packaged in new labeled containers.
 - 4. Inoculant: Use inoculant that has a manufacturer’s container, indicating the specific legume seed to be inoculated and the expiration date. All inoculant must meet requirements of the Iowa Seed Law. Follow precautions specified on the product label.
 - 5. Sticking agent: Use a commercial sticking agent recommended by the manufacturer of the inoculant. For quantities less than 50-pounds, the sticking agent need not be a commercial agent, but requires approval by the Engineer. Apply sticking agent separately prior to application of inoculant. Follow safety precautions specified on the product label.

Common Name	Scientific Name	Purity (%)	Germination (%)
DOMESTIC GRASSES:			
Bluegrass, Kentucky	Poa pratensis	98	85
Brome, smooth	Bromus inermis	90	85
Fescue, tall-Fawn	Festuca arundinacea-Fawn	98	85
Fescue, chewings, red, hard	Festuca rubra var. cummutata	98	85
Fescue, creeping, red, hard	Festuca rubra	98	85
Fescue, red-Pennlawn	Festuca rubra-Pennlawn	98	85
Fescue, Sheeps	Festuca ovina	98	85
Orchardgrass	Dactylis glomerata	90	90
Red Top	Agrostis alba	92	85

Wildrye, Russian	<i>Elymus junceus</i>	95	85
Ryegrass, Perennial	<i>Lolium perenne</i>	95	90
Timothy	<i>Phleum pratense</i>	99	90

LEGUMES:			
Alfalfa, Ranger/Vernal	<i>Medicago sativa</i>	99	90*
Alfalfa, Travois	<i>Medicago spp.</i>	99	90*
Birdsfoot Trefoil Empire	<i>Lotus coniculatus</i>	98	85*
Crownvetch, Emerald	<i>Coronilla varia</i>	98	70*
Hairy Vetch	<i>Vicia villosa</i>	96	85*
Lespedeza, Korean	<i>Lespedeza stipulacea</i>	98	80*
Red Clover, medium	<i>Trifolium pratense</i>	99	90*
White Clover	<i>Trifolium repens</i>	98	90*

NURSE CROP OR STABILIZING CROP:			
Oats	<i>Avena sativa</i>	97	90
Rye	<i>Secale cereale</i>	97	90

*Includes hard seed.

Common Name	Scientific Name	Min. PLS (%)
IOWA NATIVE GRASSES:		
Big Bluestem	<i>Andropogon gerardii</i>	30
Little Bluestem	<i>Andropogon scoparius</i>	30
Switchgrass	<i>Panicum virgatum</i>	63
Indiangrass	<i>Sorghastrum nutans</i>	60
Sideoats Grama	<i>Bouteloua curtipendula</i>	30
Prairie Dropseed	<i>Sporobolus heterolepis</i>	65
Sand Lovegrass	<i>Eragrostis trichodes</i>	65
Weeping Lovegrass	<i>Eragrostis curvula</i>	65
Hairy Wood Chess	<i>Bromus purgans</i>	60
Blue-Joint Grass	<i>Calamagrostis canadensis</i>	47
Bottlebrush Sedge	<i>Carex comosa</i>	62
Tussock Sedge	<i>Carex stricta</i>	78
Fox Sedge	<i>Carex vulpinoidea</i>	64
Virginia Wildrye	<i>Elymus virginicus</i>	60
Reed Manna Grass	<i>Glyceria grandis</i>	50
Fowl Manna Grass	<i>Glyceria striata</i>	72
Common Rush	<i>Juncus effusus</i>	80
Rice Cut Grass	<i>Leesia oryzoides</i>	62
Fowl Bluegrass	<i>Poa palustris</i>	72
Green Bulrush	<i>Scirpus atrovirens</i>	45
Wool Grass	<i>Scirpus cyperinus</i>	78
Soft-Stem Bulrush	<i>Scirpus validus</i>	78
Spike Rush	<i>Eleocharis palustris</i>	71
Wildrye, Canada	<i>Elymus canadensis</i>	80

6. If the purity and/or germination of native grasses exceed the minimum required, the application rate may be adjusted based on PLS.

Common Name	Scientific Name	PLS (%)
FORBS:		

Canada Anemone	Anemone canadensis	72
Marsh Milkweed	Asclepias incarnate	25
New England Aster	Aster novae-angliae	25
Swamp Aster	Aster puniceus	25
Showy Tick-Trefoil	Desmodium canadense	25
Joe-Pye Weed	Eupatorium maculatum	66
Boneset	Eupatorium perfoliatum	41
Ox Eye Sunflower	Heliopsis helianthoides	38
Blue-Flag Iris	Iris virginica-shrevii	19
Tall Blazingstar	Liatris pycnostachya	24
Great Blue Lobelia	Lobelia siphilitica	13

2.2 SEED MIXTURES AND SEEDING DATES

- A. Refer to the specified seed mixture. Contractor may submit a modification of the mixture for the Engineer’s consideration.
- B. Permanent Lawn Mixture: Used for residential and commercial turf site, fertilized, typically mowed, Use between March 1 and May 31 and between August 10 and September 30:

Common Name	Application Rate lb/acre
Creeping red Fescue	25
Turf-type perennial ryegrass ²	20
Turf-type perennial ryegrass ²	20
Kentucky bluegrass cultivar ³	65
Kentucky bluegrass cultivar ³	65
Kentucky bluegrass cultivar ³	65

¹ A commercial mixture may be used if it contains a high percentage of similar bluegrasses, it may or may not contain creeping red fescue.
² Choose two different cultivars of turf-type perennial ryegrass.
³ Choose three different cultivars of Kentucky bluegrass.

- C. Low Maintenance Mixture: Use between March 1 and May 31 and between August 10 and September 30:

Common Name	Application Rate lb/acre
Fine leaf Turf-type Fescue 3	150
Red Top 10	10
Perennial ryegrass	20
Creeping Red Fescue	20

- D. Urban Temporary Erosion Control Mixture: Short-lived (6-8 months) mix for erosion control:

Common Name	Application Rate lb/acre
SUMMER – May 21 – August 14	
Annual Ryegrass	40
Oats	95

2.3 **FERTILIZER**

- A. Grade: Identify the grade of fertilizer according to the percent nitrogen (N), percent of available phosphoric acid (P₂O₅), and percent water soluble potassium (K₂O), in that order, and base approval on that identification.
- B. Contractor may substitute other fertilizer containing analysis percentages different from those specified, provided that the minimum amounts of actual nitrogen, phosphate, and potash per acre are supplied, and that in no case does the total amount per acre of the 3 fertilizer elements be exceeded by 30 percent of the following minimum amounts:
- C. **For conventional seeding, permanent:** Apply a 13-13-13 commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate of 450-pounds per acre.
- D. **For conventional seeding, temporary:** Apply commercial fertilizer to all seeded areas at the rate of 450-pounds per acre of 13-13-13 (or equivalent) unless otherwise specified in the Contract Documents.
- E. **For hydraulic seeding:** Apply fertilizer in combination with seeding by a hydraulic seeder and as specified in Iowa DOT Article 2601.04, H. Apply a 13-13-13 commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate of 450-pounds per acre.
- F. **For pneumatic seeding:** Based on the compost nutrient analysis, supply any additional commercial fertilizer necessary to meet the 13-13-13 units of nitrogen, phosphate, and potash at the rate of 450-pounds per acre as the compost is applied.
- G. Type: Use fertilizer that can be uniformly distributed by the application equipment. Furnish fertilizer either as separate ingredients or in chemically-combined form.

2.4 **STICKING AGENT**

- A. Use a sticking agent that is a commercial material recommended by the manufacturer to improve adhesion of inoculant to the seed. For small quantities less than 50-pounds, the sticking agent need not be a commercial agent, but it must be approved by the Engineer and must be applied separately, prior to application of inoculant.
- B. Follow safety precautions specified on the product label. A sticking agent is not required if a liquid formulation of inoculant is used.

2.5 **INOCULANT FOR LEGUMES**

- A. An inoculant is a culture of bacteria specifically formulated for each legume seed (alfalfa, clovers, lespedesa, birdsfoot trefoil, hairy vetch, and crown vetch).

2.6 **WATER**

- A. Use water that is free of any substance harmful to seed germination or plant growth.

2.7 **MULCH**

- A. For conventional seeding:

1. Material used as mulch may consist of the following:
 - a. Dry cereal straw (oats, wheat, barley, or rye).
 - b. Prairie hay.
 - c. Wood excelsior composed of wood fibers, at least 8-inches long, based on an average of 100-fibers, and approximately 0.024-inch thick and 0.031-inch wide. Fibers must be cut from green wood and be reasonably free of seeds or other viable plant material.
 2. Do not use other hay (bromegrass, timothy, orchard grass, alfalfa, or clover).
 3. All material used as mulch must be free from all noxious weed, seed-bearing stalks, or roots and will be inspected and approved by the Engineer prior to its use.
 4. Contractor may use other materials, subject to the authorization of the Engineer.
- B. For hydraulic seeding:
1. Wood cellulose:
 - a. Use material that is a natural or cooked cellulose fiber processed from whole wood chips, or a combination of up to 50 percent recycled paper (by volume).
 - b. Product contains a colloidal polysaccharide tackifier adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing.
 - c. Form a homogeneous slurry of material, tackifier, and water.
 - d. Use a slurry that can be applied with standard hydraulic mulching equipment.
 - e. Dye the slurry green to facilitate visual metering during application.
 - f. Do not use materials that have growth or germination-inhibiting factors or any toxic effect on plant or animal life when combined with seed or fertilizer.
 2. Bonded fiber matrix (BFM):
 - a. Produced from long-strand wood fibers, held together by organic tackifiers and bonding agents that, when dry, become insoluble and non-dispersible.
 - b. Upon curing 24 to 48-hours, form a continuous, 100 percent coverage, flexible, absorbent, erosion-resistant blanket that encourages seed germination.
 - c. Manufactured to be applied hydraulically.
 - d. Physical properties:
 - i. Fibers: Virgin wood, greater than 88 percent of total volume.
 - ii. Organic material: Greater than 96 percent of total volume.
 - iii. Tackifier: 8 to 10 percent.
 - iv. pH: 4.8 minimum.
 - v. Moisture content: 12 percent +/- 3 percent.
 - vi. Water-holding capacity: 1.2-gal/lb.
 3. Mechanically-bonded fiber matrix (MBFM):
 - a. Produced from long-strand wood fibers and crimped, interlocking synthetic fibers.
 - b. Within 2-hours of application, form a continuous, 100 percent coverage, flexible, absorbent, porous, erosion-resistant blanket that encourages seed germination.
 - c. Manufactured to be applied hydraulically.
 - d. Physical properties:
 - i. Wood fibers: 73 percent minimum.
 - ii. Tackifier: 10 percent +/- 1 percent.
 - iii. Crimped, interlocking synthetic fibers: 5 percent +/- 1 percent.
 - iv. Moisture content: 12 percent +/- 3 percent.

- C. For pneumatic seeding: Use compost meeting the following requirements:
1. Derived from a well-decomposed source of organic matter.
 2. Produced using an aerobic composting process, meeting Code of Federal Regulations (CFR) 503 for time, temperature, and heavy metal concentrations.
 3. No visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
 4. Certified by the U.S. Composting Council's Seal of Testing Assurance (STA) program.
 5. Conforms to chemical, physical, and biological parameters of AASHTO MP 10-03, with the following additional requirements:
 - a. Follow U.S. Composting Council's TMECC guidelines for all testing.
 - b. Organic matter content: 30 percent minimum.
 - c. pH: between 6.0 and 8.0.
 - d. Maturity (growth screening): Minimum 90 percent emergence for all compost to be vegetated.
 - e. Particle size:

Sieve Size, inches	Percent Passing*
2	100
1	90-100
3/4	65-100
3/8	0-75

* 6-inch maximum particle length.

2.8 **EQUIPMENT**

- A. Aerial equipment: When aerial application of seed and fertilizer is specified, use aerial equipment capable of providing a uniform distribution of seed and fertilizer on the specified area.
- B. Compost blower: A compost blower is pneumatic equipment to blow compost over the desired area. It may be equipped with a supplemental seed injection system.
- C. Cultipacker: Use a pull-type cultipacker with individual rollers or wheels. Cultipackers with sprocket-type spacers between the wheels may be used. The cultipacker must produce a corrugated surface on the area being compacted. Operate the cultipacker separately from all other operations, and do not attach the cultipacker to the seeder or disk, unless combined cultipacker seeder is manufactured to operate as a unit. Make provisions for addition of weight.
- D. Disk: When preparing a seedbed on ground having heavy vegetation, use a disk with cutaway blades. Make provisions for the addition of weight to obtain proper cutting depth.
- E. Endgate cyclone seeders: Endgate cyclone seeders must be suitably mounted. Movement must be provided by mechanical means. The seed drops through an adjustable flow regulator onto a rotating, power driven, horizontal disk or fan.
- F. Expanded mesh roller: Use equipment that is an open grid type or a cultipacker type, modified by covering with expanded metal mesh.
- G. Field tiller: Use equipment designed for the preparation of the seedbed to the degree specified.
- H. Gravity seeders: Gravity seeders must provide agitation of the seed, have an adjustable

gate opening, and uniformly distribute seed on the prepared seedbed. Use a seed hopper equipped with baffle plates spaced not more than 2-feet apart. The baffle plates must extend from the agitator shaft to within approximately 2-inches of the top of the seed hopper. Wind guards are required to facilitate seeding when moderate wind conditions exist and when ordered by the Engineer. Place wind guards in front or in back (or both) of the seed outlet and extend them to near the ground line. This seeder may be used for application of fertilizer.

- I. Hand cyclone seeders: Hand cyclone seeders are carried by the person dispensing seed. The seed drops through an adjustable flow regulator onto a rotating, hand driven, horizontal disk or fan.
- J. Hydraulic seeder: Use hydraulic seeding equipment with a pump rated at not less than 100-gallons per minute. Inoculant, seed, and fertilizer may be applied in a single operation. The equipment must have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks must have a means of agitation. Calibrate tanks and provide them with a calibration stick or other approved device to indicate the volume used or remaining in the tank.
- K. Interseeder / Slit seeder: An interseeder/slit seeder is an implement that cuts a slit into the soil and drops the seed into the slit.
- L. Mowers: Use mowers that are rotary, flail, disk, or sickle type. Do not use mowers that bunch or windrow the mowed material.
- M. Mulch stabilizer: Use a mulch stabilizer designed to anchor straw or hay mulch into soil by means of dull blades or disks. It should have flat blades or disks, may have cutaway edges, must have a nominal minimum diameter of 20-inches, and must be spaced at approximately 8-inch intervals. The mulch stabilizer must be pulled by mechanical means and weigh approximately-1,000 pounds. When directed by the Engineer, increase the weight by addition of ballast.
- N. Native grass seed drill: Use a native grass seed drill designed to provide uniform distribution of native grass and wildflower seeds. Provide separate seed boxes to apply both small seeds as well as fluffy bearded seeds. If a no-till attachment is specified, use an attachment of the same manufacturer as the drill.
- O. Pulverizer: A pulverizer is equipment designed to break up compacted soil to prepare a seedbed.
- P. Rotary tiller: Use equipment with rotary-type blades designed for the preparation of seedbed to the degree specified.
- Q. Slope harrow: Use a slope harrow, consisting of a rolling weight attached by heavy chain to a tractor. The chain must be of suitable length, with picks attached, and a means of rotating the picks as the rolling weight is pulled in a direction parallel to the movement of the tractor.
- R. Spike tooth harrow: Use equipment designed to provide adjustment of the spike teeth to level the ground, or to be used as specified by the Engineer.
- S. Straw mulching machine: Use a machine to uniformly apply mulch material over the desired area without excessive pulverization. Engineer may consider excessive pulverization as the general absence of straw longer than 6-inches after distribution.

2.9 EROSION CONTROL NETTING

- A. Use: Under seeding where shown on the Drawings. Manufacturer: North American Green, S150BN erosion control blanket; or equivalent.
- B. Short-term double net erosion control blanket shall be a machine-produced mat of 100 percent agricultural straw with a functional longevity of up to 12-months. Blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Blanket shall be covered on the top and bottom sides with 100 percent biodegradable woven natural fiber netting. Netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 0.50 by 1.0-inch mesh. Blanket shall be sewn together on 1.50-inch centers with degradable thread. Blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2 to 5-inches from the edge) as an overlap guide for adjacent mats.
- C. Matrix: 100 percent straw fiber; 0.5-lbs per square yard. Netting: Top: Leno woven 100 percent biodegradable organic jute, 9.3-lbs per 1,000 square foot; Bottom: 100 percent biodegradable organic jute, 7.7-lbs per 1,000 square foot.
- D. Standard roll size:
 - 1. Width: 6.67-feet.
 - 2. Length: 108-feet.
 - 3. Weight: 52.22-lbs.
 - 4. Area: 80-square yards.
- E. Properties:
 - 1. Thickness ASTM D6525: 0.31-inch.
 - 2. Resiliency ECTC Guidelines: 80.5 percent.
 - 3. Water Absorbency ASTM D1117: 381 percent.
 - 4. Mass / Unit Area ASTM 6475: 9.29-oz / square yard.
 - 5. Swell ECTC Guidelines: 15 percent.
 - 6. Smolder Resistance ECTC Guidelines: Yes.
 - 7. Stiffness ASTM D1388: 6.23-oz-inch.
 - 8. Light Penetration ECTC Guidelines: 10.1-inch.
 - 9. Tensile Strength –MD ASTM D6818: 189.6-lbs / foot.
 - 10. Elongation – MD ASTM D6818: 10.4 percent.
 - 11. Tensile Strength – TD ASTM D6818: 214.8-lbs / foot.
 - 12. Elongation – TD ASTM D6818: 6.8 percent.

PART 3 - EXECUTION

3.1 AREA OF SEEDING

- A. Seed all areas disturbed by construction which do not have a paved surface or an aggregate surface, as shown on the Drawings. Do not disturb areas having a satisfactory growth of desirable grasses or legumes.

3.2 CONVENTIONAL SEEDING

- A. Order of operations:
 - 1. Fertilizing.
 - 2. Seedbed preparation.
 - 3. Seed preparation/application.
 - 4. Mulching.

- B. Fertilizing:
1. Apply fertilizer immediately prior to seedbed preparation. Incorporate the fertilizer into the top 2 to 3-inches of topsoil during the seedbed preparation. Equipment that results in ruts or excessive compaction will not be permitted.
 2. Do not apply fertilizer with native grass, wildflower, or wetland seeding.
- C. Seedbed preparation, permanent:
1. Limit preparation of seedbed to areas that will be seeded immediately upon completion.
 2. Work areas accessible to field equipment to a depth of not less than 3-inches:
 - a. Use mechanical rotary tillage equipment for the preparation of seedbed on earth shoulders, urban or raised medians, rest areas, and islands.
 - b. Prepare by hand areas inaccessible to field machinery, to a depth of not less than 2-inches.
 - c. Use care that the entire width of the shoulder and areas around headwalls, wingwalls, flumes, and other structures are prepared in the manner specified.
 3. Where weed growth has developed extensively, they may be disked into the ground. If weed growth develops sufficiently to interfere with proper seedbed preparation, mow the weeds and remove them from the project at the Contractor's expense:
 - a. Use crawler type or dual-wheeled tractors for seedbed preparation.
 - b. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross section. Harrow ridging in excess of 4-inches due to operation of tillage equipment prior to rolling with the cultipacker.
 - c. Roll the area with not less than one pass of the cultipacker prior to permanent seeding.
 4. Shape and fine grade to remove rills or gullies, water pockets, undesirable vegetation, and irregularities to provide a smooth, firm, and even surface true to grade and cross-section. Disk and rototill seedbed to a minimum-3 inch depth. For lawn seeding, prepare to a fine texture and without soil lumps. Coordinate preparation of all ditches designated for special ditch control with the seedbed preparation. Till parallel to the contours.
 5. For lawn seeding, smooth the seedbed with a cultivator-type tillage tool having a rake bar or a rock rake. Pick up and remove all debris, such as rocks, stones, concrete larger than 2-inches (1/2-inch maximum stone size for lawn seeding), or roots and other objectionable material that will interfere with the seeding operation. A spring tooth cultivator may be used in lieu of a rock picker. Remove the rock by hand after each use of the cultivator; repeat the process until the soil is relatively free of rock as determined by the Engineer.
 6. Choose equipment to minimize soil compaction. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Smooth ridging in excess of 3-inches due to operation of tillage equipment prior to rolling with the cultipacker. Roll the area with at least one pass of the cultipacker. Remove ruts that develop during the sequence of operations before subsequent operations are performed. This must be completed just prior to seeding and the work reviewed by the Engineer before the seeding application,
- D. Seedbed preparation, temporary: Till the soil to a minimum depth of 5-inches with a disk, harrow, or field cultivator.
- E. Seeding:
1. Seed preparation:
 - a. Thoroughly mix all seed specified for the contract prior to placing the seed in the seed hopper. Provide 48-hours notice prior to mixing the

- seed, and give the Engineer an opportunity to witness the seed mixing. Mixing of a certified blue tag seed mix at an approved (by Iowa Crop Improvement Association) seed conditioner's facility need not be witnessed.
- b. Treat all legume seed with a commercial sticking agent to be applied prior to application of inoculant, or as a mixture when the sticking agent is compatible with other materials. A sticking agent is not required if a liquid formulation of inoculant is used.
 - c. Inoculate all legumes with a standard product humus culture before being mixed with other seeds for sowing.
 - d. Inoculate all legumes with a standard culture at the rate specified by the manufacturer of the inoculant according to Iowa DOT Article 4169.04. Do not expose inoculated seed to direct sunlight for more than 30-minutes. Re-inoculate seed that is not sown within 8-hours after inoculation prior to use. Pre-inoculated seed with manufacturer's recommended protective coating may be used in lieu of seed with Contractor-applied inoculant.
 - e. When the gravity or cyclone seeder is used for application of seed, inoculate legume seed according to the manufacturer's recommended procedures, before mixing with other grass seeds for sowing. Furnish and apply inoculant.
2. Seed application, permanent:
 - a. Prior to seeding, the seedbed will be inspected and approved by the Engineer. Use methods and procedures consistent with equipment manufacturer's recommendations; however, do not operate ground-driven equipment at speeds greater than 10-mph.
 - b. On all areas accessible to machinery, sow seed with a gravity seeder, endgate cyclone seeder, or seed drill.
 - c. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be permitted, but no other hand-seeding methods will be accepted.
 - d. The application of grass and legume seed with hand seeders on early spring work must be performed as separate operations. No mixing of the two types of seed will be permitted.
 - e. All seeded areas will have one pass with a roller or cultipacker to firm the soil.
 3. Seed application, temporary:
 - a. On areas accessible to field machinery, sow seed with an endgate cyclone seeder.
 - b. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be permitted, but no other hand-operated seeding methods will be accepted.
 - c. Cover the seed and fertilizer by lightly tilling the seeded area with a disk, rigid harrow, spring tooth harrow, or field cultivator.
 4. Seeding outside of the specified seeding dates: With the agreement of the Engineer and at the full responsibility of the Contractor, seeding operations may be conducted outside the specified seeding dates. Should the seeded areas require reseeding, it must be done as specified and at the Contractor's expense:
 - a. Dormant seeding: When winter dormant seeding is allowed or specified by the Jurisdiction, complete it when air temperatures are consistently below 40°F and prior to December 25 of a given year. Dormant seeding is not allowed on snow.
 - i. Prepare the seedbed before the ground freezes.
 - ii. To ensure protection of the seed, apply on a frosty morning or before a predicted snow.
 - iii. Seeding may be done by hand or with seeding equipment.

- iv. For hydraulic seeding, apply the fertilizer at no more than 0.5-pounds nitrogen per 1000-square feet, followed by the seed.
 - b. Frost seeding (overseeding):
 - i. Complete frost seeding, also referred to as overseeding, in the spring when the ground is friable from frost action (February 1 to April 1).
 - ii. Frost seeding is not allowed on more than 1-inch of snow.
 - iii. Seeding can be done with a hand-operated cyclone seeder or other equipment.
- F. Mulching:
- 1. Mulch all conventionally seeded areas the same day the seed is sown. Uniformly distribute the mulch over the required areas at a rate of 1.5-tons / acre for dry cereal straw, 2-tons / acre of wood excelsior, or 2-tons / acre for prairie hay. Prairie hay is not suitable for Type 1 (lawn seeding).
 - 2. Work the mulch into the soil with a mulch tucker designed to anchor the mulch into the soil by means of dull blades or disks. Operate equipment in a manner to minimize displacement of the soil and disturbance of the design cross-section.

3.3 HYDRAULIC SEEDING

- A. Order of operations:
 - 1. Seedbed preparation
 - 2. Seed application, fertilizing, and mulching
- B. Seedbed preparation:
 - 1. Area shall be free of stones and debris.
 - 2. Thoroughly till topsoil by disking or harrowing to level out undulations and irregularities and to destroy weed seedlings.
 - 3. Rake surface to produce fine soil texture before seeding.
- C. Seed preparation: Inoculant, in the quantities specified above, may be applied directly into the supply tank with seed, water, and other material.
- D. Seed application, fertilizing, and mulching:
 - 1. Place all material, seed, fertilizer, mulch, and tackifier (if applicable) in hydraulic mulching equipment specifically manufactured for hydraulic seeding. Do not apply fertilizer with native grass, wildflower, or wetland seeding.
 - 2. Ensure that the hydraulic equipment, pump, and application process do not damage or crack seeds.
 - 3. Mix materials with fresh potable water using a combination of both recirculation through the equipment's pump, and mechanical agitation to form a homogeneous slurry.
 - 4. If necessary, dampen dry, dusty soil, to prevent balling of the material during application.
 - 5. Apply the slurry evenly over all specified areas at component material rates specified:
 - a. Wood cellulose mulch:
 - i. Mulch: Minimum 2600-lb/acre dry weight.
 - ii. Tackifier: Minimum 50-lb/acre.
 - b. Bonded fiber matrix: Minimum 3600-lb/acre dry weight.
 - c. Mechanically-bonded fiber matrix: Minimum 3600-lb/acre dry weight.
 - 6. Retain and count empty bags of mulch to ensure final application rate.

3.4 PNEUMATIC SEEDING

- A. Order of operations:
 1. Seedbed preparation
 2. Seed preparation
 3. Seed application
- B. Seedbed preparation: Follow seedbed preparation for conventional seeding in Paragraph 3.2.
- C. Seed preparation: Follow seed preparation for conventional seeding in Paragraph 3.2. Pre-inoculate seed in the quantities specified above prior to placing in the seed equipment.
- D. Seed application:
 1. Place all material, seed, fertilizer, and compost in equipment with a calibrated seeder attachment specifically designed for pneumatic seeding. Do not apply fertilizer with native grass, wildflower, or wetland seeding.
 2. Apply the compost evenly over specified areas at material rates specified.
 3. Inject seed and fertilizer into the top 1/4 to 1/2-inch of compost during application with a calibrated seed injector at the specified rate.

3.5 EROSION CONTROL NETTING

- A. Install according to manufacturer's instructions.

3.6 WATERING

- A. Provide water, equipment, transportation, water tanker, hoses, sprinklers, and labor necessary for the application of water.
- B. Use enough water to keep the soil and mulch moist to a depth of 1-inch and ensure growth of the seed. For turf-grass seeding areas, sufficiently water to keep the soil moist for a minimum of 21-days. If natural rainfall is adequate to keep the soil and mulch moist, artificial watering may not be needed.

3.7 RE-SEEDING

- A. Contractor is responsible for turning over to Owner a full stand of grass; Contractor shall re-seed and redevelop any bare spots or areas which do not attain a full stand during the first growing season.
- B. When all work related to seeding, fertilizing, and / or mulching has been completed on an area, and is washed out or damaged by acts of nature, Contractor shall re-seed, fertilize, and / or mulch the area at a negotiated additional lump sum price.
- C. When work related to seeding, fertilizing, and/or mulching has not been completed in an area, and is washed out or damaged, re-seed, fertilize, and/or mulch the area as necessary, at the Contractor's expense.

3.8 CLEANUP

- A. Remove all excess materials, debris, and equipment upon completion of work.
- B. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.
- C. Repair any damage resulting from seeding operations.

- D. Remove hydraulic slurry and other excess debris related to seeding operations from buildings, landscaping, mulch, pavement, and any other areas not specified for application, at the end of each day.

End.

DIVISION 40 – PROCESS INTERCONNECTIONS

SECTION 40 05 00

PROCESS PIPING

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PART 2 – PRODUCTS

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- 2.3 Couplings and Adapters.
- 2.4 Piping Insulation.

PART 3 – SCHEDULE

- 3.1 Piping Schedule

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. All process piping, fittings, accessories and appurtenances shown or specified and required for complete piping systems within structures. Include all connections to all treatment units, equipment and controls.
- B. All piping, fittings, and accessory materials necessary for piping not shown on Drawings. This piping includes:
 - 1. Vents and drains.
 - 2. Piping required for proper operations of piping system equipment, including drain valves for low points in piping. No additional compensation allowed for drain piping and small valves.
 - 3. Connections to all monitoring and other instruments and control apparatus, including pressure gauges and other appurtenances required for satisfactory operation of piping system and proper functioning of instruments and controls.
 - 4. Piping required for chemical feed systems.
 - 5. Piping required for potable and non-potable water systems.
 - 6. All flanges, unions, bolts, gasket material, reducing fittings, bushings and adapters.

1.2 SUBMITTALS

- A. Include the following information as a minimum:
 - 1. Identify pipe service, design temperature, and material to be used for each service.
 - 2. Proposed adapters between dissimilar piping materials.
 - 3. Pipe material, pressure class and/or schedule number.

1.3 RELATED SECTIONS

- A. Section 40 05 00 – Process Piping
- B. Section 40 05 07 – Pipe Hangers, Supports, and Anchors.
- C. Section 40 24 00 – Liquid Chemical Piping and Valves.

PART 2 – PRODUCTS

2.1 PIPE MATERIALS

- A. Ductile-iron pipe (DI): AWWA C115/A21.15 manufactured in accordance with AWWA C150/A21.50 thickness Class 52.
1. Joints: shall be working pressure rating equal to the pressure rating of the connected pipe. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.
 2. Flanges: AWWA C110/A21.10. Gaskets, bolts and nuts shall be provided with flanged joints in sufficient quantity for the complete assembly of each joint.
 - a. Bolts, Nuts, and Washers: ASTM A 307, Grade B.
 - b. Gaskets: 1/8-inch thick plain rubber (SBR) per AWWA C110/A21.11.
 3. Fittings: Flanged conforming to AWWA C110/A21.10, rated for 250 psi service.
 4. Bolt circle and bolt holes of the flanges shall conform to Class 150 flanges per ANSI B16.1.
 5. For tie-in to existing flanges, field check existing flanges for nonstandard bolt hole configurations and design as required to assure new pipe and flange mate properly.
 6. Lining: Standard cement lining with seal coat conforming to AWWA C104/A21.4.
 7. Coating: Pipe shall receive shop surface preparation, shop priming, and field painting. See Section 09 96 00.
- B. Stainless Steel (SS): ASTM A312, ASTM A778, and ASTM A774.
1. Grade: TP316
 2. Thickness: Schedule 10S with dimensions conforming to ASME B36.19M, unless otherwise specified.
 3. Joints: Piping shall be joined by welded fittings or flanges. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.
 4. Fittings:
 - a. Welded: Butt-welding fittings conforming to ASTM A403/A403M Grade TP316.
 - b. Flanges: Internal bores of flanges and flanged fittings shall be the same as associated pipe. Flanges shall be welding neck or socket type. Flanges and flanged fittings shall be ASTM A182/182M Grade TP316, Class 150 ASME B16.5 flat face. Gaskets, bolts, and nuts shall be provided with flanged joints in sufficient quantity for the complete assembly of each joint.
 - i. Bolts, Nuts, and Washers: 316SS.
 - ii. Gaskets: 1/8-inch thick full face type.
- C. Polyvinyl Chloride, (PVC and CPVC): ASTM D-1784, Type 1, Grade 1 pipe. Schedule 80.
1. Joints: Shall be Socket Weld, Flanged, Threaded, or Grooved
 2. Fittings:
 - a. Socket Type: ASTM D-2567, Solvent cement conforming to ASTM D2565 or F493.
 - b. Flange Type: F-439 and D-4024.
 - c. Threaded type; ASTM D-2464 and F-437.
 - d. Grooved Type; Grooved mechanical couplings 316SS or composite with 316SS Bolts, nuts and washers.

2.2 PIPE THROUGH WALLS AND SLABS

- A. Wall pipes:
1. Provide wall pipes with intermediate flanges on all wet face to exposed dry face concrete walls and floors. Material to be ductile-iron unless noted. Pipe ends to match connecting piping.

2. Clow Corporation; or equivalent.
 3. Fabricate wall pipes to dimensions required to suit requirements or conditions.
 4. Space intermediate flange to center in wall or floor or as shown on Drawings.
 5. Refer also to details shown on the Drawings.
- B. Wall sleeves:
1. Provide wall sleeves where shown on Drawings.
 2. Refer also to details shown on the Drawings.
 3. Clow Corporation; or equivalent.
- C. Mechanical seals:
1. Use wall sleeves on new construction where shown for pipes passing through floors, walls, or roof slabs.
 2. Core drill holes in existing concrete construction for pipes passing through floors, walls or slabs.
 3. Materials: Cast iron or polyethylene with intermediate flange on piping 3-inches and larger. Galvanized stainless steel pipe with anchor ring or lugs on piping smaller than 3-inch.
 4. Sleeve length: Extend 2-inches above floors, flush with other surfaces.
 5. Clearance: As recommended by seal manufacturer.
 6. Seal: Mechanical, link-type, modular, field- assembled, insulating, positive-sealing; Thunderline/Leak Seal "Link-Seal," Advance Product & Systems, Inc.; or equivalent.
 7. After seal is installed, place non-shrink grout over bolts in annular space between pipe and wall sleeve.

2.3 COUPLINGS AND ADAPTERS

- A. Restrained Flexible Couplings and Flanged Coupling Adapters:
1. Couplings shall me AWWA C219.
 2. Materials:
 - a. Castings: Ductile Iron Meeting ASTM A 536
 - b. Gaskets: Compounded for water and sewer service per ASTM D200.
 - c. Bolts and Nuts: 304 stainless steel.
 3. Pressure rating:
 - a. 350 psi.
 4. Compatible pipe materials: Ductile Iron, Cast Iron, PVC (IPS, C900, C905).
 5. Acceptable Manufacturers: Krausz Hymax Grip, Romac Alpha, EBAA 3800 Mega-Coupling, or equal.

2.4 PIPING INSULATION

- A. Insulation shall be manufactured from mineral substance such as rock, slag, or glass, processed from a molten state into fibrous form with or without binder.
- B. Insulation shall be provided for piping as shown on drawings or as called for in process piping schedule.
- C. Molded pipe insulation shall be manufactured to meet ASTM C 585 for sizes required in the particular system.
- D. Molded fibrous glass pipe insulation shall comply with ASTM C 547.
- E. The following systems shall be used:
1. Indoor piping systems:

- a. Owens Corning Fiberglas Pipe insulation with factory applied all-service jacket (ASJ) and two-component adhesive closure system (SSL-II).
 - b. Operating temperature from 0° to 850°F.
 - c. Insulated with minimum 2" thick insulation.
 - d. Contractor to install insulation around all control devices on piping to insure access and uninhibited observation and operation.
2. Outdoor exposed piping systems:
- a. Piping shall be insulated as indicated above except that insulation shall be protected by metal jacketing.
 - b. Metal jacketing shall be 0.016" minimum aluminum or stainless steel with moisture barrier, secured in accordance with the jacket manufacturer's requirements. Joints shall be applied so they will shed water and shall be sealed completely.
 - c. Insulated with minimum 4" thick insulation.
 - d. Contractor to install insulation around all control devices on piping to insure access and uninhibited observation and operation.

PART 3 – SCHEDULE

3.1 PROCESS PIPING SCHEDULE

<u>LOCATION/PROCESS</u>	<u>MATERIAL</u>
CHEMICAL BULDING – SLAKER ROOM	
Non-Potable Water System	PVC
Carbon Slurry	PVC/HDPE

End.

SECTION 40 05 07

PIPE HANGERS, SUPPORTS AND ANCHORS

INDEX

PART 1 – GENERAL

- 1.1 Description.
- 1.2 Related Sections.
- 1.3 Quality Assurance.
- 1.4 Submittals.
- 1.5 Job Conditions.

PART 2 – PRODUCTS

- 2.1 Acceptable Manufacturers.
- 2.2 Materials.
- 2.3 Horizontal Piping Hangers and Supports.
- 2.4 Vertical Piping Clamps.
- 2.5 Hanger Rods and Attachments.
- 2.6 Building Attachments.
- 2.7 Saddles and Shields.
- 2.8 Miscellaneous Materials.

PART 3 – EXECUTION

- 3.1 General.
- 3.2 Installation of Building Attachments.
- 3.3 Thrust Anchors and Guides.
- 3.4 Pipe Supports.

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Furnish complete system of pipe supports and anchors, with necessary inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, and other accessories.
- B. Absence of pipe supports and details on Drawings shall not relieve Contractor of responsibility for providing them throughout the facility.

1.2 RELATED SECTIONS

- A. Section 01 10 00: Summary of Work.
- B. Section 40 05 00: Process Piping.
- C. Section 40 24 00: Liquid Chemical Piping and Valves.

1.3 QUALITY ASSURANCE

- A. Source quality control:
 - 1. Firms regularly engaged in manufacture of pipe supports, hangers, anchors and related products.
 - 2. Provide factory fabricated piping hangers and supports, clamps, hanger rod attachments, building attachments, saddles, shields, thrust anchorage, and other miscellaneous products indicated or shop fabricated supports. Comply with MSS

SP-58 and manufacturer's published product information. Where MSS type not indicated, provide proper selection for installation requirements and comply with MSS SP-58 and manufacturer's published product information.

- B. Design criteria: Pipe support system components shall withstand dead loads imposed by weight of pipes filled with water plus insulation, valves or fittings, internal pressures, pump/blower vibrations, horizontal/vertical thrusts and have a minimum safety factor of 5.
- C. Reference Standards:
 - 1. Manufacturer's Standardization Society (MSS):
 - a. MSS SP58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.
 - 2. American Society for Testing and Materials (ASTM):
 - a. ASTM A36-81A - Specification for Structural Steel.
 - b. ASTM A307 - Specification for Carbon Steel Externally Threaded Standard Fasteners.
 - 3. American National Standards Institute (ANSI): ANSI B31.1-1983 - Power Piping.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 00.
- B. Pipe supporting system, including manufacturer's product data, dimensions, sizes, types, location, maximum loadings, thrust anchorage, and installation instructions.

1.5 JOB CONDITIONS

- A. Support piping, in general, as described hereinafter. MSS types indicated are typical of types and quality of standard pipe supports and hangers to be employed.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Unistrut; Eaton B-Line; Grinnell; Carpenter-Paterson; or equivalent.

2.2 MATERIALS

- A. Stainless Steel shall be used for piping hanger and support system material in all areas of facility, except in hazardous chemical storage and feed areas.
- B. Hazardous, chemical storage and feed areas:
 - 1. Provide a non-metallic hanger and support system which includes all necessary fasteners, channel splice plates, brackets, sealants, hangers, clamps, etc.
 - 2. Nonmetallic fasteners shall be manufactured from long glass fiber reinforced polyurethane to ensure strength and corrosion resistance.
 - 3. System Manufacturer:
 - a. Fiberglass System by Unistrut, Eaton B-Line, or equivalent.

2.3 HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. General:
 - 1. Unless otherwise shown or specified, hangers for 2-1/2-inch and smaller pipe shall be split-ring, adjustable swivel, clevis or roller type. Hangers for 3-inch pipe or greater shall be clevis or roller type.

2. Hangers for use with spring supports shall be split-ring or clamp type.
 3. Hangers for fiberglass reinforced pipe shall be saddle type.
 4. Each hanger shall be designed to permit at least 1-1/2 inch vertical adjustment after installation.
- B. Adjustable swivel split-ring hanger: MSS Type 6.
 - C. Adjustable clevis hanger: MSS Type 1
 - D. Adjustable band hanger: MSS Type 7
 - E. Adjustable swivel-band hanger: MSS Type 10.
 - F. Clamp: MSS Type 4.
 - G. Single roll support: MSS Type 41, including axle roller and threaded sockets.
 - H. Adjustable roller hanger: MSS Type 43, including axle roller and clevis.
 - I. Roll / Stand: MSS Type 44, including roller, stand and axle.
 - J. Adjustable roll / base: MSS Type 46, including roller, adjustable base, and stand.
 - K. Brackets:
 1. Structural Shapes complying with:
 - a. Light duty: MSS Type 31.
 - b. Medium duty: MSS Type 32.
 - c. Heavy duty: MSS Type 33.
 - L. Adjustable saddle support: MSS Type 38, including saddle, pipe and reducer.
 - M. Stanchion saddle support: MSS Type 37, including saddle and U-bolt.
 - N. Strap or wire hangers not acceptable.

2.4 VERTICAL PIPING CLAMPS

- A. 2-Bolt riser clamp: MSS Type 8.
- B. 4-Bolt riser clamp: MSS Type 42, include pipe spacers at inner bolt holes.

2.5 HANGER RODS AND ATTACHMENTS

- A. Hanger rods:
 1. Threaded both ends or continuous threaded.

2. Rods shall conform to following sizes:

Pipe Size	Minimum Rod Diameter, inches
Up to 2-inch	3/8
2-1/2 to 3-inch	1/2
4-inch	5/8
6-inch	3/4
8 to 12-inch	7/8
14-inch and larger	1
Trapeze hangers	As required

- B. Turnbuckles: MSS Type 13.
- C. Weldless eye nut: MSS Type 17.
- D. Eye socket: MSS Type 16.
- E. Clevis: MSS Type 14.

2.6 BUILDING ATTACHMENTS

- A. Individual concrete inserts:
 - 1. MSS Type 18.
 - 2. MSS Type 19.
 - 3. Minimum safe load: 1,100 lbs.
- B. Continuous concrete inserts:
 - 1. Unistrut, P-3200 Series.
 - 2. Fee and Mason, Figure 9000.
 - 3. Superstrut.
 - 4. Or equivalent.
- C. Top beam c-clamp: MSS Type 19.
- D. C-clamps: MSS Type 23.
- E. Channel clamp: MSS Type 20.
- F. Top I-beam clamp: MSS Type 25.
- G. Side beam clamp: MSS Type 27.
- H. Concrete anchors: Minimum safety factor: 5.

2.7 SADDLES AND SHIELDS

- A. Protection saddles: MSS Type 39.
- B. Protection shields: MSS Type 40.
- C. Wood insulation saddle: Elcen Metal Products Company; or equivalent.

2.8 MISCELLANEOUS MATERIALS

- A. Framing systems:
 - 1. Unistrut.
 - 2. Fee and Mason.
 - 3. Or equivalent.
- B. Shop fabricated anchors and supports:
 - 1. Steel plates, shapes and bars.
 - 2. Restraining rods.
 - 3. Fabricate in accordance with Section 05 50 00.
- C. Concrete: In accordance with Section 03 30 00.

PART 3 – EXECUTION

3.1 GENERAL

- A. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed and concrete support structure has reached 28-day compressive strength as specified in Section 03 30 00.
- B. Install hangers, supports, clamps, and attachments from building structure; comply with MSS SP-58. Group parallel runs of horizontal piping to be supported together on trapeze type hangers where possible.
- C. Install supports to provide indicated pipe slopes and maximum pipe deflections allowed by ANSI B31.1 are not exceeded.
- D. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- E. Install supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Piping shall be free to move when expands or contracts, except where fixed anchors are indicated. Where adequate hanger rod swing length cannot be provided or where pipe movement based on expansion of 1-inch per 100-feet for each 100°F change in temperature exceed ½-inch, provide approved roller supports.
- G. Support piping 2-inch and larger on trapeze hangers on rollers.
- H. Prevent contact between dissimilar metals. Where concrete or metal pipe support is used, place 1/8-inch thick Teflon, asbestos, neoprene rubber or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and support.
- I. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, plastic coated or by other recognized industry methods. Electrician's tape is not acceptable isolation method.
- J. Apply anti-seize compound to nuts and bolts.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

- A. Support piping from structural framing, unless otherwise noted.
- B. Concrete inserts:
 - 1. Locate inserts so total load on insert does not exceed manufacturer's recommended maximum load. Location of inserts shall be approved by Engineer.
 - 2. Where necessary to anchor supports to hardened concrete or completed masonry, use concrete anchors.
- C. Attach to structural steel with beam clamps.
- D. Do not support piping from other piping.

3.3 THRUST ANCHORS AND GUIDES

- A. Thrust anchors:
 - 1. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and be sufficiently rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and preclude separation of joints.
 - 2. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead ending of pipe lines. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.
 - 3. Restraining rod size and number shall be as recommended by MSS.
- B. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with recommendations of National Association of Expansion Joint Manufacturers.

3.4 PIPE SUPPORTS

A. Spacing:

Type of Pipe, Size in inches	Maximum Pipe Support Spacing, feet
Steel	
10 and larger	22
8	19
6	17
4	14
3-1/2	13
3	12
2-1/2	11
2	10
1-1/2	9
1	7
3/4	6
1/2	5
Copper	
4	12
3-1/2	11
3	10
2-1/2	9
2	8
1-1/2	8
1-1/4	7
1	5
3/4	5
1/2	5
Plastic – Schedule 80 at 100°F	
8	9-1/2
6	9
4	7-1/2
3	7
2	6
1-1/2	5-1/2
1	5
3/4	4-1/2
1/2	4-1/2
For plumbing application plastic piping shall be supported at maximum of 4-foot spacing.	

Cast-Iron and Ductile-Iron	
30 and larger	20
24	18
20	18
18	16
16	16
14	16
12	14
10	12
8	12
6	12
4	10
3	10
For plumbing application cast-iron and ductile-iron piping shall be supported at maximum of 5-feet spacing.	

- B. Where piping of various sizes is to be supported together, space supports for smallest pipe size or install intermediate supports for smaller diameter pipe.
- C. Provide minimum of 2 pipe supports for each pipe run.
- D. Where piping connects to equipment, support by pipe support and not equipment, unless approved by equipment manufacturer.
- E. Unless otherwise shown or authorized by Engineer, place piping running parallel to walls approximately 1-1/2-inch out from face of wall and at least 3-inches below ceiling.
- F. Pedestal pipe supports shall be adjustable with stanchion, saddle, and anchoring flange.
- G. Piping supports for vertical piping passing through floor sleeves shall be riser clamps.
- H. Support piping in manner preventing undue strain on valve, fitting or equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise shown. Do not install pipe supports and hangers in equipment access areas.
- I. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.
- J. Where coatings are required paint hangers, clamps, protective shields, metal framing support components, and hanger accessories in accordance with Section 09 96 00.

End.

SECTION 40 24 00

LIQUID CHEMICAL PIPING AND VALVES

PART 1 – GENERAL

- 1.1 Summary
- 1.2 Submittals

PART 2 – PRODUCTS

- 2.1 Pipe Materials
- 2.2 Tubing Materials
- 2.3 Ball Valves
- 2.4 Backpressure/Anti-Siphon Valves
- 2.5 Pressure Relief Valves

PART 3 – SCHEDULE

- 3.1 Chemical Piping and Valve Schedule

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes all process pipe, fittings, valves, accessories and appurtenances shown or specified and required for complete chemical transfer and feed piping systems with connections to all storage units, equipment and controls.
- B. All Chemical storage and feed pipe, fittings, valves and accessory materials necessary for piping not shown on plans; this piping includes:
 - 1. Tank Vents and drains.
 - 2. Piping required for proper operations of piping system equipment, include drain valves for low points in piping, no additional compensation allowed for drain piping and small valves.
 - 3. Connections to instruments and control apparatus, include pressure gauges and other appurtenances required for satisfactory operation of piping system and proper functioning of instruments and controls.
 - 4. Piping required for chemical feeders.
 - 5. All flanges, unions, bolts, gasket material, reducing fittings, bushings and adapters.
- C. Related Sections:
 - 1. Section 40 05 07 – Pipe Hangers and Supports
 - 2. Section 43 41 43 – High Density Cross-Linked Polyethylene Tanks
 - 3. Section 46 33 00 – Liquid Chemical Feed Systems
 - 4. Section 46 33 83 – Liquid Chemical Feed Auxiliary Equipment and Accessories

1.2 SUBMITTALS

- A. Include following information as minimum:
 - 1. Identify pipe service and material to be used for each.
 - 2. Proposed adapters between dissimilar pipe.
 - 3. Pipe material, wall thickness, class and/or schedule number.
 - 4. Valve types, sizes, weights, dimensions, materials, locations and pressure ratings.
 - 5. Valve operator types, sizes, weights, dimensions and materials.

PART 2 – PRODUCTS

2.1 PIPE MATERIALS

- A. Polyethylene (PE):
 - 1. Provide Chem Proline piping system as supplied by Asahi/America, Inc.
 - a. Provide pressure rated pipes, pipe fittings and valves.
 - 2. Install piping to comply with manufacturer's recommended procedures, hot gas and extrusion welding shall not be allowed.
 - a. Fittings: Socket or Butt.

- B. Chlorinated Polyvinyl Chloride, (CPVC):
 - 1. Schedule 40, or Schedule 80, as indicated on in piping schedule, ASTM D-1784, Type IV, Grade 1 Gray, NSF 14 and NSF 61.
 - 2. Fittings:
 - a. Socket Type:
 - i. Sch. 40; ASTM D-2466, F-438.
 - ii. Sch. 80; ASTM D-2467, F-439.
 - b. Flange Type:
 - i. Socket and Spigot; ASTM F-439.
 - ii. Bolt Patter; ANSI B16.5, ASTM D-4024.
 - 3. Joints:
 - a. Solvent Cement;
 - i. Specified for CPVC carrying corrosive chemicals.
 - ii. ASTM F-493.
 - iii. UPC and NSF 61 Certified.
 - iv. Weld-On 724, or Approved equivalent.
 - 4. System: Corzan, or approved equivalent.

- C. Polyvinylidene Fluoride (PVDF):
 - 1. Schedule 80 or SDR 21; ASTM D3222 Type I or Type II, NSF 61
 - 2. Fittings: Socket or Butt.
 - 3. Joining: Heat Fusion:
 - a. Socket; DVS-2208
 - b. Butt; DVS-2207
 - 4. Systems: Chemtrol Natural Kynar, Asahi Super Proline, or approved equivalent.

2.2 TUBING MATERIALS

- A. High Density Polyethylene (HDPE):
 - 1. Material: Natural high quality high-density polyethylene meeting NSF 61 standards
 - 2. Wall Thickness: 1/16-inch.
 - 3. Working Pressure: 151 psi @ 73°
 - 4. Fittings:
 - a. Compression type, as manufactured by JACO Manufacturing Co.
 - b. Polypropylene construction with plastic gripper.
 - c. Pressure rating to be equal to or greater than tubing
 - d. NSF 61 listed

- B. Polyvinylidene Fluoride (PVDF):
 - 1. Material: Natural translucent PVDF; ASTM D3222 meeting NSF 61 standards
 - 2. Wall Thickness: 1/16-inch.
 - 3. Working Pressure: 104 psi @ 72°
 - 4. Fittings:
 - a. Compression type, as manufactured by JACO Manufacturing Co.

- b. Polyvinylidene Fluoride construction with plastic gripper.
 - c. Pressure rating to be equal to or greater than tubing
 - d. NSF 61 listed
5. Systems: Kynar-Flex, Hylar, or equivalent

2.3 BALL VALVES

- A. Thermoplastic Ball Valves:
- 1. Body Materials:
 - a. CPVC shall conform to ASTM D1784 Cell Classification 23567-A meeting NSF 61.
 - b. PVDF shall conform to ASTM D3222 Type I or Type II meeting NSF 61 Standards.
 - 2. True Union Design with two-way blocking capability.
 - 3. O-rings: EPDM or FKM
 - 4. Seats: PTFE
 - 5. Design: True union with two-way blocking capability.
 - 6. Pressure Rating: 230psi
 - 7. Manufacturer: Asahi/America Inc., or equal.

PART 3 – SCHEDULE

3.1 CHEMICAL PIPING SCHEDULE

<u>CHEMICAL SYSTEM</u>	<u>Ferric Chloride</u>
Tank Fill	CPVC
Tank Overflow	CPVC
Tank and System Vents	CPVC
Header Piping	PE
Chemical Feed System	PE
Chemical Feed to Injection	HDPE

End.

SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

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PART 1 – GENERAL

- 1.1 Description
- 1.2 Requirements
- 1.3 Submittals

PART 2 – PRODUCTS

- 2.1 Float Switches.

PART 3 – EXECUTION

- 3.1 Installation

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This Section describes control devices and equipment required to accomplish system control functions.
- B. Related Work Specified Elsewhere:
 - 1. Division 26 - Electrical

1.2 REQUIREMENTS

- A. Furnish and install control devices and equipment including float switches, level sensors, flow measurement, pressure gauges, and analyzers.
 - 1. Guarantee all equipment against defects in material and workmanship for period of two years after acceptance of project by Owner.
 - 2. Manufacturer's representative or service organization shall maintain stock parts for equipment supplied and provide service 7 days per week and be available within 24 hours upon verbal notice. Service during guarantee periods shall be considered incidental to the project and no charges will be paid.

1.3 SUBMITTALS

- A. Control Equipment:
 - 1. Provide equipment dimensional drawings, wiring diagrams, catalog data and other information necessary to describe the equipment. Provide equipment cross reference dated to show compliance with specification.
- B. Provide complete installation, operation and maintenance instructions.
- C. Transmit submittals in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.1 FLOAT SWITCHES

- A. Provide float switches in accordance with this specification and installed as indicated below:

1. Ferric Chloride Feed Piping Structures (Quantity = 2).
- B. Switches: 12 amp, 120 volt, single phase mercury glass tube switch encased in leakproof, shockproof, corrosion-resistant, solid polytetrafluoroethylene (PTFE) float, suitable for ferric chloride applications.
- C. Cords: 300 volt, oilproof, 2 conductor, Type SJO, AWG Size 16 flexible cord; provide cast iron weight coated with baked-on epoxy paint to hold switch at desired height.
- D. Junction Boxes: box with terminal strips for wires; individually seal each wire with clamped rubber gasket; seal switch cords with compression fittings. All float switch circuits located in hazardous classified areas shall be provided with intrinsically safe circuit barriers.
 1. Provide easily removable round cover sealed with rubber O-ring.
 2. Provide bosses on box for mounting support bracket.
- E. Provide support brackets with plastic cord snubbers to hold switches at required height; height adjustable by lowering or raising cord in cord snubber.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install all control equipment at locations shown on drawings or directed by Engineer.
- B. Installation to be in strict accordance with manufacturer's instructions.

End.

**DIVISION 43 – PROCESS GAS AND LIQUID HANDLING,
PURIFICATION, AND STORAGE EQUIPMENT**

SECTION 43 41 43

HIGH DENSITY CROSS-LINKED POLYETHYLENE STORAGE TANKS

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PART 1 – GENERAL

- 1.1 Summary
- 1.2 References, Codes, and Standards
- 1.3 Submittals
- 1.4 Quality Assurance
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PART 2 – PRODUCTS

- 2.1 General
- 2.2 Manufacturer
- 2.3 Polyethylene Storage Tanks
- 2.4 Tanks
- 2.5 Level Indication
- 2.6 Factory Testing

PART 3 – EXECUTION

- 3.1 Delivery, Storage, and Handling
- 3.2 Installation
- 3.3 Field Testing

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes high density cross-linked polyethylene tanks, tank fittings, accessories, and other appurtenances for use in liquid chemical feed systems.
- B. Related Section:
 - 1. Section 01 10 00 – Summary of Work
 - 2. Section 01 33 00 – Submittal Procedures
 - 3. Section 40 24 00 – Liquid Chemical Piping and Valves
 - 4. Section 46 33 00 – Liquid Chemical Feed Systems
 - 5. Section 46 33 83 – Liquid Chemical Feed Auxiliary Equipment and Accessories

1.2 REFERENCES, CODES AND STANDARDS

- A. American Society of Testing Materials (ASTM).
 - 1. D638 - Tensile Properties of Plastics
 - 2. D883 - Standard Definitions of Terms Relating to Plastics
 - 3. D1505 - Density of Plastics by the Density-Gradient Technique
 - 4. D1525 - Test Method for Vicat Softening Temperature of Plastics
 - 5. D1693 - ESCR Specification Thickness 0.125" F50-10% Igepal
 - 6. F412 - Standard Terminology Relating to Plastic Piping Systems
- B. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings
- C. Building Code: International Building Code - IBC 2015
- D. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure).

- E. NSF/ANSI Standard 61, AWWA – Drinking Water System Components
- F. ASTM D-1998, Standard Specification for Polyethylene Upright Storage Tanks

1.3 **SUBMITTALS**

- A. Shop Drawings: Shop drawings shall be approved by the engineer or contractor prior to the manufacturing tanks. Submit the following as a single complete initial submittal. Sufficient data shall be included to show that the product conforms to Specification requirements. Provide the following additional information:
 - 1. Tank and Fitting Material
 - a. Resin Manufacturer Data Sheet
 - b. Fitting Material
 - c. Gasket style and material
 - d. Bolt material
 - 2. Dimensioned Tank Drawings
 - a. Location and orientation of molded in fitting (if applicable), openings, fittings, accessories, restraints and supports.
 - b. Details of inlet and molded outlet fitting (if applicable), manways, flexible connections, and vents.
 - 3. Calculations shall be stamped and signed by a registered, third party engineer in the State of the installation.
 - a. Wall thickness. Hoop stress shall be calculated using 600 psi @ 100 degrees F.
- B. Manufacturer's warranty.
- C. Manufacturer's unloading procedure.
- D. Manufacturer's installation instructions.
- E. Supporting information of Quality Management System.
- F. Supporting documentation of Manufacturer's certification that the complete tank system (tank, fittings, gaskets, fasteners) meets NSF/ANSI Standard 61 – Drinking Water System Components for the specified water treatment chemicals.
- G. Manufacturer's Qualifications: Submit to engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.
- H. Electrical heat tracing and foam insulation data sheets, as required.
- I. Factory Test Report
 - 1. Material, specific gravity rating at 600 psi @ 100 degrees F. design hoop stress.
 - 2. Wall thickness verification.
 - 3. Fitting placement verification including molded in outlet (IMFO®)
 - 4. Visual inspection
 - 5. Impact test
 - 6. Gel test
 - 7. Hydrostatic test

1.4 QUALITY ASSURANCE

- A. The CONTRACTOR shall provide a vertical, high density cross-linked polyethylene tank with full drain capability and molded in flange. The tanks of the same material furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacture of chemical storage tanks for over 10 years.
- B. Tanks shall be manufactured from virgin materials.
- C. Complete tank systems shall be manufactured from materials certified to NSF/ANSI Standard 61 for chemical storage and submit form from NSF supporting chemical certification.

1.5 WARRANTY

- A. Manufacturer shall provide a limited 5 year full replacement warranty.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Tanks shall be rotationally-molded, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat / sloping bottoms in axis.
- B. Tanks shall be adequately vented.
- C. As required, tanks shall be provided with ancillary mechanical fittings and accessories.
- D. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

2.2 MANUFACTURER

- A. Tanks shall be manufactured by Poly Processing Company or Engineer approved equal.

2.3 POLYETHYLENE STORAGE TANKS

- A. Service: Chemical storage tanks shall be suited for the following operating conditions per this section.
- B. High Density Cross-linked Polyethylene resin used in the tank manufacture shall be Poly CL™ or equal and shall contain ultraviolet stabilizer as recommended by resin manufacturer. Where black tanks are indicated, the resin shall have a carbon black compounded into it. The tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.
- C. For sodium hypochlorite and sulfuric acid storage, resin shall include additional medium density polyethylene (OR-1000) with four times the antioxidant properties of a standard polyethylene bonded to the interior surface during the manufacturing process.
- D. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi. In NO case shall the tank thickness be less than design requirements per ASTM D 1998.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$$T = P \times OD/2SD \text{ or } 0.433 \times SG \times H \times OD/2SD$$

Where: T = wall thickness, in
P = pressure, psi
SG = specific gravity, gm/cc
H = fluid head, ft
OD = outside diameter, ft
SD = hydrostatic design stress, 600 psi

- a. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187" thick.
2. On closed top tanks the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.
3. If bottom head is integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	Min Knuckle Radius, in
less than or equal to 6	1
greater than 6	1-1/2

4. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.
 - a. Unless otherwise indicated by Contract drawings, for indoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with an emergency pressure relief device or SAFE-Surge™ Manway with pressure relief at 6" water column to prevent over-pressurization. The SAFE-Surge manway shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.
 - b. Unless otherwise indicated by Contract drawings, for outdoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with combined manway and vent to prevent over pressurization of tank. Manway must be capable of relieving a volume flow rate of up to 2650 ACFM. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.
 - c. Unless otherwise indicated, tanks less than 2000 gallons in non-pneumatic applications shall have a manway cover 17-in or smaller of Polyethylene material with a coarse thread. Gaskets shall be closed cell, cross-linked polyethylene foam, viton or EPDM materials.

E. Tank colors shall be natural un-pigmented.

2.4 TANKS

A. Tank characteristics shall be per the following schedule:

<u>CHEMICAL SERVICE</u>	<u>Ferric Chloride</u>
Quantity	Four (4)
Nominal Capacity (gallons)	3,000
Diameter (feet)	7'-1"
Height (feet)	12'-0"
Color	Natural off-white
Gasket Material	PE/EPDM

B. Fittings

1. Tank fittings shall be according to the fitting schedule in 2.5.A above. Threaded fittings shall use American Standard Pipe Threads. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.
2. Integrally Molded Flanged Outlet Fittings (IMFO®). These outlets must be an integral part of the tank, molded from the same material as the tank and provide complete drainage of liquid through the sidewall of the tank. Metal and alloy inserts shall not be used.
3. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be color coded for visual ease of identifying the bolt material by onsite operators. Green- 316 Stainless Steel, Black- Titanium, Red- Alloy C-276, Blue- Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.
4. For sodium hypochlorite and sulfuric acid storage, Bolted One-Piece Sure Seal (B.O.S.S.), double flange fittings constructed of virgin polyethylene shall be supplied. Bolts will be welded to a common backing ring and encapsulated with polyethylene preventing fluid contact with the metal material. Flange will have one full face gasket to provide a sealing surface against inside tank wall. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied
5. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be CPVC or material compatible with the chemical stored.
6. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F) (iii)(2)(IV)(9). U-vents shall be sized by the tank manufacturer and be furnished complete with insect screen if required (Insect screen lessens the vent capacity by 1/3) in accordance with the venting schedule listed above.
7. All fittings on the 1/3 lower sidewall of tanks with capacities \geq 1000 gallons shall have 100% virgin PTFE Flexi-joint® expansion joint. Expansion joint to have a

minimum of 3 convolutions, stainless steel limit cables and FRP composite flanges. Galvanized parts will not be accepted. Expansion joint to meet the following minimum performance requirements:

- a. Axial Compression $\geq 0.67''$
- b. Axial Extension $\geq 0.67''$
- c. Lateral Deflection $\geq 0.51''$
- d. Angular Deflection $\geq 14^\circ$
- e. Torsional Rotation $\geq 4^\circ$

2.5 LEVEL INDICATION

- A. Tank to include sidewall graduations to indicate fluid volume, in gallons.

2.6 FACTORY TESTING

- A. Material Testing
 1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.
 2. Degree of Cross-linking. Use Method C of ASTM D 1998- Section 11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.
- B. Tank Testing
 1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 2 degrees radially.
 2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking
 3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. AVOID sharp objects on trailers.
- B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.
- C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Poly Processing Company shall be notified immediately.

3.2 INSTALLATION

- A. Install the tanks in strict accordance with Poly Processing Company's Tank Installation Manual and shop drawings.
- B. Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection tank system(s) to be reviewed using tank manual check list as supplied by manufacture as listed below.

- C. Manufacturer to provide 1 hour training session to prepare operators to service and maintain the tank system. Included in training session will be three (3) training manuals.
- D. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.
- E. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.3 FIELD TESTING

- A. Poly Processing Company recommends that all tanks be hydro-tested for 24 hours prior to commissioning.

End.

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 46 33 00

LIQUID CHEMICAL FEED SYSTEMS

INDEX

PART 1 – GENERAL

- 1.1 Summary.
- 1.2 Reference Standards.
- 1.3 Submittals.
- 1.4 Quality Assurance.

PART 2 – PRODUCTS

- 2.1 General.
- 2.2 Chemical Feed Systems Required.
- 2.3 Metering Pumps.
- 2.4 System Description.
- 2.5 Chemical Tanks
- 2.6 Manufacturer.

PART 3 – EXECUTION

- 3.1 Installation.
- 3.2 Manufacturers Services
- 3.3 Warranty

PART 1 – GENERAL

1.1 SUMMARY

- A. The Chemical Feed System shall be the standard equipment of the supplier involved in the manufacture of similar type equipment and shall be as manufactured by VESSCO, Inc.
- B. Chemical Metering Pumps will be provided by Owner. Chemical Metering Pumps to be installed and commissioned by Contractor.
- C. This specification addresses skid mounted chemical systems complete with the skid assembly containing all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The chemical skid shall contain the following items:
 - 1. Skid with drip lip
 - 2. Mounting bases for metering pumps (by Owner)
 - 3. Calibration column
 - 4. Pulsation dampeners
 - 5. Pressure gauges with diaphragm seals
 - 6. Ball valves
 - 7. Pressure relief valves
 - 8. Backpressure valves
 - 9. Anti-siphon valves
 - 10. All piping, valves, gaskets, supports, hardware, wiring, and accessories necessary for a fully functioning skid.
- D. Equipment of a different type, size, weight or design of that specified herein can be offered. However, such equipment shall be acceptable only on the basis of the following.
 - 1. Any revisions in the design and/or construction of the structure, piping,

- appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner.
2. Changes in scope of equipment and performance thereof shall be the responsibility of the Contractor.
 3. All modifications to the scope shall be pre-approved by the Engineer 21 days prior to bid and must be determined to be the equal of that specified.
- E. Related Work:
1. Section 40 24 00 Liquid Chemical Piping and Valves
 2. Section 46 33 83 Liquid Chemical Feed Auxiliary Equipment and Accessories

1.2 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. American National Standard Institute (ANSI)
 2. Occupational Safety and Health Administration (OSHA)
 3. National Electrical Manufacturers Association (NEMA)
 4. National Electrical Code (NEC)
 5. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS

- A. Contractor shall provide all submittals in accordance with the requirements of Section 01 33 00 Submittal Procedures.
- B. Product Data:
 1. One (1) electronic copy of submittal data will be supplied for the system.
 2. Component data and shop drawings of the system will be supplied, including dimensions, weight, and parts list.
 3. When applicable control panel elevation, control schematics and component data will be supplied.
- C. Record Documents: Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
- D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01 70 00, Closeout Submittals.

1.4 QUALITY ASSURANCE

- A. Manufacturer shall have minimum ten (10) years' experience in manufacturing Chemical Feed Systems.
- B. All equipment provided under this section shall be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness and proper installation of the Chemical Feed System.

- C. To insure quality and unit responsibility, the Chemical Feed System must be assembled and tested by the manufacturer at its facility and be a standard regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff and fabricating personnel to complete the work specified. Skids assembled by a second party fabricator, integrator or contractor shall not be acceptable.
- D. Prior to shipment the Chemical Feed System shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and connection whisker-free. The Chemical Feed System shall be tested under pressure for a minimum of one hour at 100 psi. If leaks are found they shall be fixed and a new test shall be conducted for an additional hour at 100 psi until the Chemical Feed System is verified to be leak free.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. The feed system shall be specially designed, constructed and installed for the service intended and shall comply with the conditions listed in the schedule in Section 2.2 below. The VENDOR shall submit compatibility data from the manufacturer being supplied to confirm the materials of construction
- C. The skid mounting of the chemical feed system shall conform the following requirements:
 - 1. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the drawings and shall include brackets for the metering pumps, calibration column, antisiphon protection, piping, valves, piping accessories (pulsation dampeners, basket strainers, etc.), and wiring integral to the skid. The chemical feed system supplier shall be responsible for providing all equipment, valves and piping within the skid boundary.
 - 2. The skids shall be constructed of a minimum 1/2" thick fiberglass with adequate supports for all equipment and piping. Fork lift truck cut outs be provided for wall-mounted unit only. The polypropylene material shall be UV protected and shall be suitable for either floor or wall mounting as specified below or in project drawings.
 - 3. All components of the skid-mounted system (pumps, piping and controls) shall be tested prior to shipment as described in Part 1.4.D.
 - 4. Piping and fittings shall be Asahi Chem Proline.
- D. Calibration Chamber: Provide one, calibration chamber per chemical feed system with vent, for use in calibrating the metering pumps.
 - 1. The chamber shall be sized to give adequate capacity for a minimum 60 second draw down test.
 - 2. The scale shall give direct readings in GPH and ML/MIN without the need for calculations.
 - 3. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pumps.
 - 4. The top of the chamber shall have a fitting to allow for piping to a common vent.
- E. Pulsation Dampeners:

1. Pulsation dampeners shall be of the single diaphragm design, capable of arresting water hammer in the pump discharge lines created by the metering pumps. The pulsation dampener shall dampen flow pulsations a minimum of 95 percent.
 2. Pulsation dampeners shall be provided with valves, gauges and fittings necessary for maintaining required air pressure in the air chamber.
 3. Materials of construction of diaphragm and body shall be corrosion resistant to the chemical fluid pumped.
 4. Provide one dampener on the discharge side of each metering pump.
 5. Each pulsation dampener shall include an integral pressure gauge.
- F. Piping, Valves and Appurtenances: Reference Section 40 24 00
1. See Section 40 24 00 Liquid Chemical Piping and Valves.
 2. Tru-union Isolation valves shall be provided for isolation of major equipment.
- G. Back Pressure and Pressure Relief Valves;
1. Provide one type of each valve for each metering pump.

2.2 CHEMICAL FEED SYSTEMS REQUIRED

<u>CHEMICAL FEED SYSTEM</u>	<u>Ferric Chloride</u>
Chemical	Ferric Chloride
Concentration (%)	40%
Specific Gravity	1.41
Temperature (F)	60°-100°
Number of Pumps (Qty.)	2
Feed Rate (GPH)	53
Pressure (psig)	150
Discharge Point (Qty.)	2

2.3 METERING PUMPS

- A. General
1. Pumps will be provided by Owner. Pumps to be installed and commissioned by Contractor.

2.4 SYSTEM DESCRIPTION

- A. General
1. All wetted surfaces of feed pumps and all sealing gaskets shall be suitable for continuous exposure to chemical service shown on the pump schedule.
 2. All wetted surfaces shall be of materials suitable for contact with potable water and shall not leach out any organic or inorganic constituent that is not permitted by local or federal regulations.

2.5 CHEMICAL TANKS

- A. Chemical tanks as specified in Section 43 41 43.

2.6 MANUFACTURER

- A. Basis of design for chemical feed system skid equipment is VESSCO, Inc.
 B. Bulk chemical tanks by Poly Processing Co, Norwesco Inc., or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. The equipment shall be installed per the contract documents and manufacturer's recommendations.
 - 1. Provide a manufacturer's certificate showing the equipment has been satisfactorily calibrated and tested.
 - 2. An authorized manufacturer's representative shall inspect the installation of all work furnished under this section and shall provide a certificate of proper installation.

3.2 MANUFACTURERS SERVICES

- A. The manufacturer or manufacturer's representative shall provide the services of an experienced, authorized representative the equipment specified herein who shall be present at the jobsite and/or classroom designated by the City/District for the minimum man-days listed for the services shown below time travel excluded
 - 1. One man-day per site for inspection, start-up, functional testing and certificate of proper installation.
 - 2. One man-day per site for training and commissioning.
 - 3. Supplier must have capabilities to manufacturer in their own shop
 - 4. Skid manufacturer must be within two hours of installation.

3.3 WARRANTY

- A. Chemical feed system shall be warranted for a period of 12 months from the date of start-up by authorized technician.
- B. Damage due to makeup water particulates will not be considered as a warranty defect and will be the responsibility of the owner.

End.

SECTION 46 33 83

LIQUID CHEMICAL AUXILIARY EQUIPMENT AND ACCESSORIES

INDEX

PART 1 – GENERAL

- 1.1 Description.
- 1.2 Basic Requirements.
- 1.3 Submittals
- 1.4 Warranty.

PART 2 – PRODUCTS

- 2.1 Ultrasonic Level Transducers.

PART 3 – EXECUTION

- 3.1 Installation.
- 3.2 Supervision.

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Section describes chemical feed system auxiliary equipment which includes but is not limited to: transfer pumps, scales, inline mixers, chemical injectors and other accessories as shown on the Drawings and specified hereinafter.
- B. Related Work:
 - 1. Section 01 10 00 Summary of Work.
 - 2. Section 01 33 00 Submittal Procedures.
 - 3. Division 26: Electrical
 - 4. Section 40 05 00 Process Piping.
 - 5. Section 40 05 07 Pipe Hangers, Supports and Anchors.
 - 6. Section 40 24 00 Liquid Chemical Piping and Valves.
 - 8. Section 43 41 43 High Density Cross-Linked Polyethylene Storage Tanks
 - 9. Section 46 33 00 Liquid Chemical Feed System

1.2 BASIC REQUIREMENTS

- A. Furnish and install all equipment and accessories at the locations shown on Drawings and specified herein. All equipment shall be supplied by the same supplier. Supplier shall verify that each component is compatible with all other chemical feed system components.
- B. Manufacturer of each component to furnish services of factory / field engineer for one (1) 8-hour working day at site to inspect installation, witness initial system startup and instruct Owner's personnel concerning maintenance and operation requirements of chemical feed equipment.

1.3 SUBMITTALS

- A. Shop Drawings: Complete fabrication and installation drawings and schematics, including layout, dimensions, component weights, details, anchorage inserts and installation

information necessary to show compliance with specifications and recommended installation procedures.

- B. See Section 01 33 00, Submittal Procedures for Additional Requirements.

1.4 WARRANTY

- A. Supplier shall provide a warranty for all pump tube assemblies, tanks, controls and appurtenances for a period of 2-years.

PART 2 – PRODUCTS

2.1 ULTRASONIC LEVEL MONITOR

- A. Provide bulk tank ultrasonic level monitors in accordance with the Level Monitor Schedule in Part 2.1 B.
- B. Level Monitor Schedule

<u>CHEMICAL STORAGE SYSTEM</u>	<u>Ferric Chloride</u>
<u>TOTE LEVEL MONITOR</u>	
Quantity	4
Range	9"-196"
Mounting	2" NPT
Manufacturer	Siemens
Model	The Probe

- C. Ultrasonic sensor shall be of the "self-contained" type, outputting a 4-20 mA signal proportional to the tank level.
- D. Sensor shall have a NEMA 4X housing.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install equipment as indicated on the Drawings and as specified herein. Provide level bearing surface under all areas of the storage tanks.
- B. Provide and install incidental items such as piping to provide complete operating storage and feed system as shown on chemical system schematic drawings.

End.

SECTION 46 36 33

VOLUMETRIC FEED EQUIPMENT

INDEX

PART 1 – GENERAL

- 1.1 Summary
- 1.2 Related Sections
- 1.3 References (Not used)
- 1.4 Submittals
- 1.5 Measurement and Payment (Not used)

PART 2 – PRODUCTS

- 2.1 Dust Collector
- 2.2 Silo Monitoring Unit
- 2.3 Bin Activator
- 2.4 Knife Gate Valve
- 2.5 Rotary Airlock Valve
- 2.6 Volumetric Feeder and Mixing Tank
- 2.7 Pretesting

PART 3– EXECUTION

- 3.1 General
- 3.2 Receiving, Transporting, and Storing
- 3.3 Protection
- 3.4 Cleaning of Equipment
- 3.5 Installation
- 3.6 Manufacturer Services
- 3.7 Cleanup

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide and install the following equipment for the powder activated carbon feed system.
 - 1. Dust collector.
 - 2. Bin activator.
 - 3. Knife gate valve.
 - 4. Rotary airlock valve.
 - 5. Volumetric feeder and mixing tank.
- B. Compressed air process piping, electrical connections, and controls to be installed by Contractor.

1.2 RELATED SECTIONS

- A. Division 01 – General Requirements

1.3 REFERENCES (NOT USED)

1.4 SUBMITTALS

- A. Submit a complete set of the following information:
 - 1. Properly identified catalog data for all components of equipment and other necessary information and cross-references to prove complete compliance with specifications.

2. Certified dimensional drawings showing general arrangement, assembly, and installation details of equipment.
3. Detailed wiring diagrams.
4. Recommended spare parts list.
5. See Division 01 – General Requirements for additional requirements.

1.5 MEASUREMENT AND PAYMENT (NOT USED)

PART 2 – PRODUCTS

2.1 DUST COLLECTOR

- A. Dust collector suitable for filtering powder activated carbon dust with the following properties:
 1. Apparent density – 0.42 – 0.48.
 2. Iodine number average – 500.
 3. Mean pore radius – 12-18 Angstroms.
 4. Tannin Value – 900 max.
 5. pH – 6-8.
 6. Phenol number average g/l – 1.2-3.0.
 7. Surface area m/g min. – 750.
 8. Ash wt., % max. – 10.
 9. Moisture (as packed) wt. % max. – 8.
 10. Wet screen analysis, minus .325 USS, %
 - a. 99% minus 100 mesh.
 - b. 95% minus 200 mesh.
 - c. 90% minus 325 mesh.
 11. Conforms to AWWA Standard B600-90.
 12. NSF Approved – Certificate No. 062097-MH25593.
- B. Cartridge type dust collector with pulse-jet cleaning system.
- C. 12-gauge carbon steel housing with epoxy coating.
- D. Approximate connection flange dimensions – 49.25" (North-South) by 42.25" (East-West).
- E. Truck unloading pressure – 8 psig maximum through a 4-inch unloading pipe.
- F. Available power – 480V/3 ph/60 Hz.
- G. Provide side-mounted fan on discharge of dust collector.
- H. Hinged access door with T-handles or equivalent tool-free access.
- I. Provide control panel with 4-20mA signals, to be included with Owner's controls.
 1. Manufacturer provided control panel with timers and photohelic differential pressure gauge/pressure switches to automatically cycle compressed air to dislodge material on filters. 4-20mA output on differential pressure gauge for remote monitoring by others.
- J. NEMA 4 requirements.
- K. Photohelic gauge w/4-20 mA output.
- L. Compressed air system, electrical connections, and controls by Owner.
- M. Recommended Models.
 1. MAC Bin Vent Model 39AVRC14-13, Style 2, with MAC Model SB17 Fan (reference quotation No. 094136MAC-R2).
 - a. The GSI Company, P.O. Box 633, 1928 Marshall, Boone, IA 50036.
 - b. Representative: Kory Gustafson; Office: (515)-963-9735; Cell: (515)-306-7082.
 2. Donaldson-Torit CPV-3 bin vent, with TRB-3 Fan (reference quotation from Enpro Technologies/Vessco dated November 5, 2009).
 - a. Vessco, Inc., 8217 Upland Circle, Chanhassen, MN 55317.

- b. Representative: Craig Wilson; Office: (952)-941-2678 ext. 640; Cell: (612)-805-4058.
- N. Provide connection to ductwork sized per manufacturer's recommendation, as indicated in Drawings.

2.2 SILO MONITORING UNIT

- A. Provide silo monitoring unit with 27-foot length (minimum).
 - 1. Acceptable Manufacturers:
 - a. SiloPatrol SE Silo Monitoring Unit
 - b. Or equal, as approved by Engineer.

2.3 BIN ACTIVATOR

- A. Carbon steel construction, with 4-foot-diameter flanged inlet for welding to existing bin, and 10-inch-diameter round outlet.
- B. Epoxy coated exterior surface, rust preventative coating on interior surface.
- C. Maximum flow of 650 lb/hr (36 cu ft/hr); minimum of 54 lb/hr (3 cu ft/hr).
- D. Discharge to rotary airlock valve.
- E. Nominal 1.5 hp grease lubricated vibrator, with TENV motor, 480V/3-phase/60 Hz.
- F. Conical baffle mounted on cross-members.
- G. Black neoprene flexible discharge sleeve.
- H. Provide two (2) 304 stainless steel sleeve clamps on discharge sleeve.
- I. Rolled angle ring and upper hanger brackets.
- J. Four (4) forged one-piece vibration isolator hangers with special rubber bushings for vibration isolation.
- K. Provide electrical connections and controls.
 - 1. Bin Activator Controls:
 - a. Hand/off/auto control of bin activator, contacts to verify selector position.
 - b. Activator motor proof of run. Aux contact or CT contact.
- L. Provide control panel with 4-20mA signals, to be included with Owner's controls.
- M. Recommended Model: Vibra Screw 4-foot Bin Discharger (reference quotation No. X-23-503), or approved equal. Submit product information for alternate equipment at bid opening, in separate envelope from bid documents.

2.4 KNIFE GATE VALVE

- A. Provide 10-inch maintenance knife gate valve to be connected with discharge of bin activator.
- B. Cast steel body, stainless steel gate with metal seat.
- C. Hand-crank actuation.
- D. Recommended Model: Vortex Global round Titan maintenance gate, carbon steel with SS blade. Non-rising manual handcrank actuator with LH acme threads (5 revolutions per inch or travel)

2.5 ROTARY AIRLOCK VALVE

- A. 10-inch-diameter inlet.
- B. Cast iron body and end plates.
- C. Closed end, 8 vane, tapered adjustable rotor.
- D. Available power – 460V/3-phase/60 Hz.
- E. 0.5 hp TENV inverter duty motor, and air purge gland seals.
- F. Provide control panel with 4-20mA signals, to be included with Owner's controls.
 - 1. Rotary Airlock Valve Controls:
 - a. Hand/off/auto control of rotary airlock valve, contacts for selector position.
 - b. Rotary airlock valve VFD , run contact.
 - c. Speed control of rotary airlock valve, 4-20mA input for speed selection.

- d. Speed control of rotary airlock valve, 4-20mA output for speed feedback.
- e. VFD alarm contacts.
- E. Recommended Model: Magnum Systems/Smoot FTP12-2 SAP 0.5 hp NORD gearmotor, 9 rpm, 0.64 fy3/rev, Closed end carbon steel rotor with replaceable bolt-on AR

2.6 **VOLUMETRIC FEEDER AND MIXING TANK.**

- A. Feeder sized for a maximum flow of 529 lb/hr (23 cf/hr) and a minimum of 7 lb/hr (0.28 cf/hr). (OK to provide 2 screw/tube sets for full feed rate range)
- B. 2 cu ft hopper with bolted cover, constructed to support weight of airlock above.
- C. Hopper cover to have 10-inch flange to match rotary airlock valve above.
- D. Provide 304 stainless steel for material in contact with powder activated carbon; non-contact material painted white epoxy.
- E. Stainless steel feed screw and tube.
- F. AC inverter duty motor, TENV enclosure, with VFD
- G. Remote touch panel with 4-20mA input (proportional to motor set speed), and zero speed switch.
- H. Provide conditioning screw to ensure flight filling.
- I. Provide flight screw with downspout and end bearing.
- J. Provide totally enclosed transition from volumetric feeder discharge into mixing tank.
- K. [2] Paddle type level probes in hopper
- L. Zero speed switch
- M. Mixing tank.
 - 1. 50 gallon size with removable cover
 - 2. 304 stainless steel construction.
 - 3. 1-inch inlet on top of tank for dilution water piping.
 - 4. Feeder inlet on top of tank for discharge from volumetric feeder.
 - 5. 2-inch outlet near top of tank side wall for overflow piping.
 - 6. 1-inch outlet near bottom of tank side wall for connection to eductor.
 - 7. Level switch and level probe.
 - 8. Inspection door.
 - 9. 1/2 hp mixer with tank mounting. 460/3/60 power
- N. Provide carbon steel stand for volumetric feeder, sandblasted and coated with epoxy paint.
- O. Manufacturer provided control panel capable of stand-alone operation that controls Bin Discharger and vibrator; Rotary Valve; Volumetric Screw Feeder, Trough Vibrator, and Mixer with a single point power supply. Provide Allen Bradley PLC with ModBus over Ethernet connection to tie into Owner's SCADA system.
 - 1. Carbon Feeder Controls.
 - a. Hand/off/auto control of feeder motor/VFD, contacts to verify Selector position.
 - b. Hand/off/auto control of mixer, contacts to verify selector position.
 - c. Zero speed switch alarm contact.
 - d. Low/high level alarms in mixing tank contacts.
 - e. Low/high level alarms in hopper contacts.
 - f. Mixer run contacts.
 - g. Auger run contact.
 - h. VFD alarm contacts.
 - i. Remote start contact for when in AUTO mode.
- P. Recommended Model: Versifeeder by Vibra Screw, Inc. (reference quotation No. X-23-503), or approved equal. Submit product information for alternate equipment at bid opening, in separate envelope from bid documents.

2.7 **PRETESTING**

- A. Equipment suppliers shall test the powder activated carbon from Des Moines Water Works' supplier, and certify the powder activated carbon is compatible with the equipment.
- B. Certifications must be reviewed and approved by Owner before equipment order is finalized.

PART 3- EXECUTION

3.1 GENERAL

- A. Protection of Owner's Property
 - 1. Protect all existing facilities from damage.
 - 2. Protect all new equipment from damage.
 - 3. Remedy any damage caused by the Work as directed by the Engineer at the Contractor's expense.
- B. Site Conditions and Safety
 - 1. Contractor shall provide the following on site at all times:
 - a. Sufficient lighting.
 - b. Ventilation equipment, if required by OSHA.
 - c. Personnel retrieval device.
 - d. Air monitoring device.
 - e. Personal protective equipment for all employees, including
 - (1) Steel-toed boots.
 - (2) **Hard hats.**
 - (3) Safety glasses.
 - 2. Provide safety barriers as required by OSHA near the top and bottom openings of the existing storage bin.
 - 3. Provide safety barriers as required by OSHA near the existing lime slurry pit on the lower level of the Chemical Building.

3.2 RECEIVING, TRANSPORTING, AND STORING

- A. Receive all shipments of equipment at job site, McMullen Water Treatment Plant, 12223 SW Maffitt Lake Road, Cumming, IA 50061; or at Des Moines Water Works Central Stores Warehouse, 412 Fleur Drive, Des Moines, IA 50321.
- B. Transport, as required, and unload at job site. Boxes, crates, pallets, or cartons may be unloaded using fork-lift vehicles or slings dependent on their size and construction.
- C. Store equipment in manner and location, which will ensure complete fitness for operation. Protect from rust, corrosion, weathering, vibration, and vandalism.
- D. Follow all other manufacturer requirements and recommendations for handling, storing, and protecting equipment.
- E. Pay all demurrage or storage charges for Contractor-supplied equipment.

3.3 PROTECTION

- A. Structures
 - 1. Use cribbing, shoring, or planking to protect structures from moving-in damage.
 - 2. Repair any damage to structures or equipment after equipment is in place.
- B. Equipment – Protect all equipment from falling objects, moisture, and water.

3.4 CLEANING OF EQUIPMENT

- A. Clean equipment of all temporary protective coatings.
- B. Remove all oil, grease, and dirt from external surfaces.

3.5 INSTALLATION

- A. Completely assemble all equipment shipped knocked down; furnish minor items such as nuts, bolts, washers, pins, and pipe fittings necessary for assembly and operation; use materials compatible with equipment.
- B. Verify vertical and horizontal clearances to ensure proper fit of equipment.
- C. Install equipment per manufacturer's instructions.
- D. Equipment shall be installed level.
- E. Any equipment damaged during installation shall be replaced by Contractor.
- F. All equipment connections shall be airtight to prevent leakage of carbon and carbon dust.
- G. Any leaks detected during equipment testing and operation shall be repaired by Contractor.
- H. Contractor to install compressed air system, process piping, electrical conduit and wiring and controls.
- I. Assist Owner in startup and testing of equipment.
- J. Furnish stainless steel bolts and fasteners not supplied with equipment.

3.6 MANUFACTURER SERVICES

- A. An authorized technical representative of the manufacturer shall visit the site to witness the following and to certify in writing that the equipment has been properly installed, aligned, lubricated, adjusted, and readied for operation.
 - 1. Installation of the equipment: 2 days.
 - 2. Inspection, checking, and adjusting the equipment: 1 day.
 - 3. Startup and field testing for proper operation: 1 day.
 - 4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements: 1 day.

3.7 CLEANUP

- A. Contractor shall completely remove all debris from construction areas.

End