

# Technical Specifications

## CITY OF MELBOURNE CHAPEL HILL PUMP STATION 2024

PREPARED FOR:

CITY OF MELBOURNE, AR  
WATER DEPARTMENT



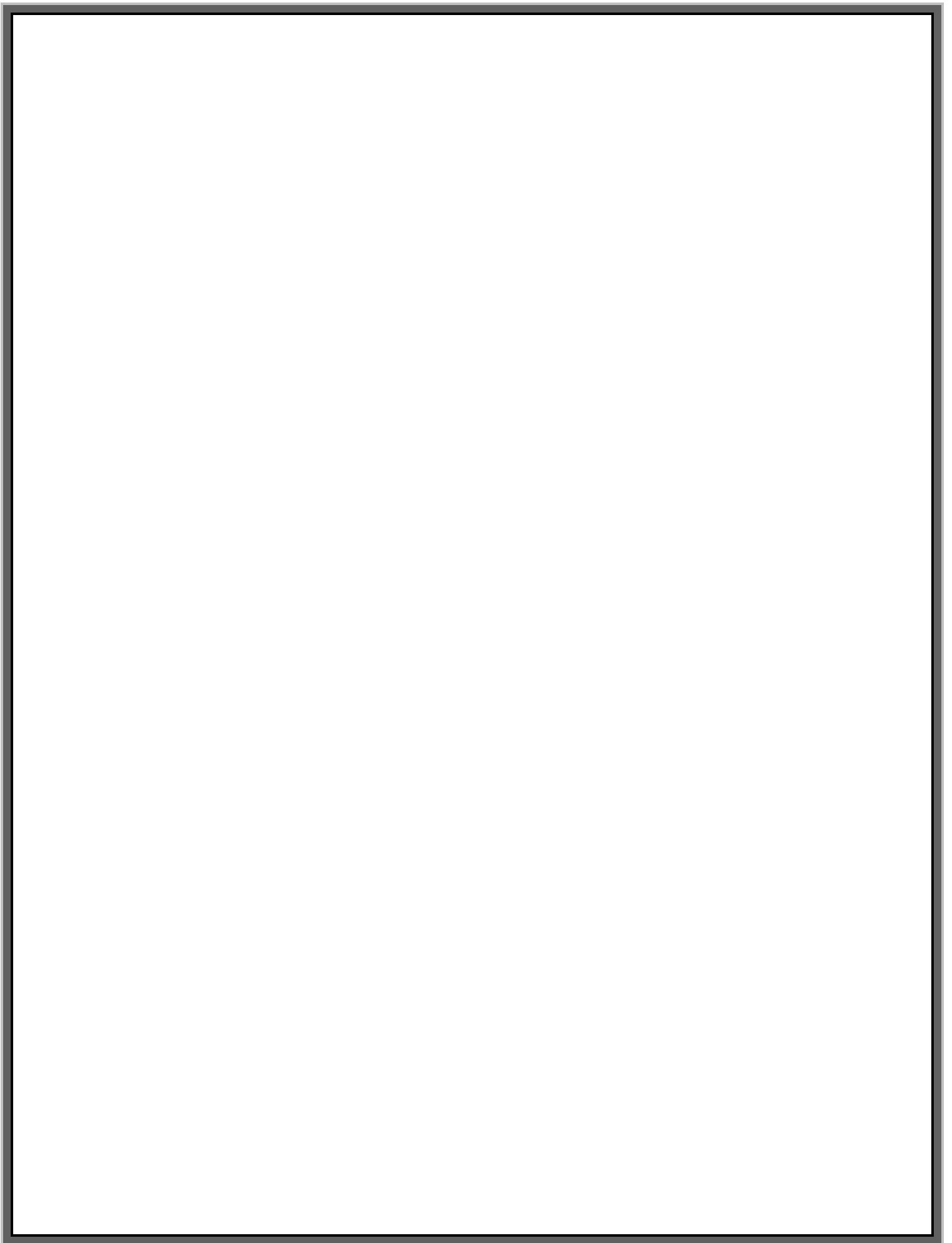
SALT ENGINEERS & PLANNERS

PROJECT NO. 39-24-01

April 2024



3/25/24



## TABLE OF CONTENTS

Section	Title
---------	-------

---

### **DIVISION 01 – GENERAL REQUIREMENTS**

011101	Summary of Work
013000	Submittal Procedures
013119	Project Meetings
014527	Equipment Testing and Startup
015000	Temporary Facilities
015700	Dust Control
015713	Temporary Erosion and Sediment Control
016400	Supports, Hangers, and Anchors
016610	Delivery, Storage, and Handling
017710	Closeout Procedures
017836	Warranties and Bonds
017839	Project Record Documents
018823	Operation and Maintenance Data

### **DIVISION 03 - CONCRETE**

031000	Concrete Formwork
032000	Concrete Reinforcement
033000	Cast-in-Place Concrete
033500	Concrete Finishes
033800	Concrete Joints & Joint Accessories
036000	Grout

### **DIVISION 04 – MASONRY**

042200	Concrete Masonry Units
042201	Water-Repellant for CMUs
042202	Water-Repellant for Mortar

### **DIVISION 05 – METALS**

055000	Miscellaneous Metals
--------	----------------------

<b>Section</b>	<b>Title</b>
----------------	--------------

---

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

- 061000 Rough Carpentry
- 061001 Carpentry
- 061600 Roof Sheathing
- 061723 Shop Fabricated Wood Trusses

**DIVISION 07 – THERMAL & MOISTURE PROTECTION**

- 071900 Water Repellent Coating
- 072100 Building Insulation
- 073000 Roofing Underlayment
- 074113 Metal Roof Panels
- 076000 Flashing & Sheet Metal

**DIVISION 08 – OPENINGS**

- 081100 Metal Door & Frames
- 087100 Door Hardware

**DIVISION 09 – PAINTING**

- 099100 Painting

**DIVISION 13 – SPECIAL CONSTRUCTION**

- 133400 Pre-Cast Concrete Buildings
- 133460 Fiberglass Equipment Shelters

**DIVISION 22 – PLUMBING**

- 221209 Pressure Gauges

**DIVISION 26 – ELECTRICAL**

- 260000 Electrical General Provisions
- 261100 Raceways, Boxes, Fittings, and Supports
- 261200 Wires and Cables

<b>Section</b>	<b>Title</b>
261410	Wiring Devices
261910	Miscellaneous Equipment
262890	Surge Protection Devices
264700	Panelboards
266000	Underground Systems
266600	Grounding System

### **DIVISION 31 – EARTHWORK**

311000	Site Preparation
312000	Earthwork
312300	Trench Excavation, Backfill, & Compacting
312319	Dewatering and Drainage
312330	Granular Materials
312500	Erosion and Sedimentation Control
312900	Topsoil and Seeding

### **DIVISION 32 – EXTERIOR IMPROVEMENTS**

321540	Gravel Surfacing
323113	Chain Link Fences & Gates

### **DIVISION 33 – UTILITIES**

330501	Pipeline Testing and Cleaning
331101	Ductile Iron Pressure Pipe and Fittings
331102	PVC Pressure Pipe
331200	Valves & Hydrants
331233	Ultrasonic Flow Meters
331300	Potable Water System Disinfection

**Section Title**

---

**DIVISION 43 – PROCESS GAS & LIQUID HANDLING, PURIFICATION, &  
STORAGE EQUIPMENT**

432100 Vertical Multi-Stage Centrifugal Package Pump Station

SECTION 01 1101  
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

- A. The work of this Contract is located along the east side of Field Rd. (County Rd 62) in Brockwell, AR 72517 north of the City of Melbourne, AR.

1.02 SCOPE OF WORK

- A. These general and detailed specifications form a part of the Contract Documents and shall govern the handling and installation of the equipment, pipe, and appurtenances.
- B. Furnish all labor, materials, equipment, and incidentals required and construct the improvements in their entirety as shown on the Plans and as specified herein.  
The Work may include, but is not necessarily limited to, the following:
  - 1. the installation of approximately 60 linear feet of 3" D.I. water main and appurtenances (suction and discharge piping)
  - 2. the installation of a 3" HYMAX and cut-in valve assembly (as detailed on plans)
  - 3. the installation of a 3" TS&V assembly
  - 4. the construction of a Precast Concrete or CMU block pump station building including pumps, piping, valves, and ancillaries
  - 5. the installation of a 36 KW generator with Automatic Transfer Switch
  - 6. mobilization and demobilization
  - 7. clearing, grubbing, earthwork, seeding, and erosion control
  - 8. site grading
  - 9. electrical and controls work
  - 10. miscellaneous appurtenances
  - 11. safety systems
  - 12. items of construction work and/or materials not specifically addressed herein, but nonetheless required for a complete, operating, and acceptable installation of the work, shall be considered subsidiary to the lump sum bid item, and the cost thereof shall be considered to be included.

1.03 CONTRACTOR'S USE OF PREMISES

- A. CONTRACTOR shall have use of the premises for the performance of the Work.
- B. CONTRACTOR shall limit the use of the premises for his/her Work and for storage to allow for:

SECTION 01 1101 – Summary of Work

1. Access to the infrastructure and equipment of the OWNER
  2. OWNER occupancy
- C. Coordinate use of premises with the OWNER.
  - D. CONTRACTOR shall assume full responsibility for security of all his/her and his/her subcontractors' materials and equipment stored on the site.
  - E. If directed by the OWNER, move any stored items which interfere with operations of the OWNER or other contractors.
  - F. Obtain and pay for use of additional storage or work areas if needed to perform the Work.
  - G. Provision of sanitary facilities for Contractor's use. See Specification Section 01-5000.

END OF SECTION



## SECTION 01 3000

### SUBMITTALS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This Section includes the requirements for compiling, processing, and transmitting submittals required for execution of the project.
- B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:
  - 1. **Action Submittal:** Written and graphic information submitted by the CONTRACTOR that requires the UTILITY's approval. The following are examples of action submittals:
    - a. Shop drawings (including working drawings and product data)
    - b. Samples
    - c. Operation & maintenance manuals
    - d. Site Usage Plan (CONTRACTOR's staging - including trailer siting and material laydown area)
    - e. Schedule of values
    - f. Payment application format
  - 2. **Informational Submittal:** Information submitted by the CONTRACTOR that does not require the UTILITY's approval. The following are examples of informational submittals:
    - a. Shop drawing schedule
    - b. Construction schedule
    - c. Statements of qualifications
    - d. Health and Safety Plans
    - e. Construction photography and videography
    - f. Work plans
    - g. Maintenance of traffic plans
    - h. Outage requests
    - i. Proposed testing procedures
    - j. Test records and reports
    - k. Vendor training outlines/plans

- l. Test and start-up reports
- m. Certifications
- n. Record Drawings
- o. Record Shop Drawings
- p. Submittals required by laws, regulations, and governing agencies
- q. Submittals required by funding agencies
- r. Other requirements found within the technical specifications
- s. Warranties and bonds
- t. As-built surveys
- u. Contract close-out documents

#### 1.02 RELATED WORK

- A. Additional requirements may be specified in the General Conditions for the Contract.
- B. Additional submittal requirements may be specified in the respective technical specification sections.
- C. Operation and Maintenance manuals are included in Section 01 8823.
- D. Contract closeout submittals are included in Section 01 7710.
- E. Warranties and Bonds are included in Section 01 7836.
- F. Applications for Payment are included in General and Supplementary Conditions.
- G. Project Record Documents are included in Section 01 7839.

#### 1.03 CONTRACTOR'S RESPONSIBILITIES

- A. All submittals shall be clearly identified as follows:
  - 1. Date of submission
  - 2. Project number
  - 3. Project name
  - 4. CONTRACTOR identification
    - a. Contractor
    - b. Supplier
    - c. Manufacturer

- d. Manufacturer or supplier representative
5. Identification of the product
6. Reference to Contract drawing(s)
7. Reference to specification section number, page and paragraph(s)
8. Reference to applicable standards, such as ASTM or Federal Standards numbers
9. Indication of CONTRACTOR's approval
10. CONTRACTOR's Certification statement
11. Identification of deviations from the Contract Documents if any
12. Reference to previous submittal (for resubmittals)

B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.

C. SUBMITTAL LOG

Maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log should include the following items (as applicable):

1. Description
2. Submittal number
3. Date transmitted to the UTILITY
4. Date returned to CONTRACTOR (from UTILITY)
5. Status of Submittal (Approved/Not Approved/etc.)
6. Date of Resubmittal to UTILITY and Return from UTILITY (if applicable and repeat as necessary)
7. Date material released for fabrication
8. Projected (or actual) delivery date

D. NUMBERING SYSTEM

Utilize a 9-character submittal identification numbering system in the following manner:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. The next six digits shall be the applicable Section Number.
3. The next two digits shall be the numbers 01 to 99 to sequentially number each separate item or drawing submitted under each specific Specification Section, in the order submitted.

4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:

D-400550-008-B

D = Shop Drawing  
40 0550 = Section for Valves  
08 = the eighth different submittal under this section  
B = the second submission (first resubmission) of that particular shop drawing.

#### E. VARIANCES

Notify the UTILITY in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

Notify the UTILITY in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the UTILITY.

#### F. ACTION SUBMITTALS

##### 1. SHOP DRAWINGS, WORKING DRAWINGS, PRODUCT DATA AND SAMPLES

###### a. SHOP DRAWINGS

- 1) Shop drawings as defined in the General Conditions, and as specified in individual Sections include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, wiring diagrams, coordination drawings, equipment inspection and test reports, including performance curves and certifications, as applicable to the work.
- 2) CONTRACTOR shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
- 3) All details on shop drawings shall show clearly the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
- 4) All shop drawings submitted by subcontractors and vendors shall be reviewed by the CONTRACTOR for field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and that it has been coordinated with other related shop drawings and the Contract requirements. Submittals directly from subcontractors or vendors will not be accepted by the UTILITY.
- 5) The CONTRACTOR shall be responsible the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the CONTRACTOR's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor

or vendor to correct before submission to the UTILITY. All shop drawings shall be approved by the CONTRACTOR.

- 6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contractor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contractor's control.

b. WORKING DRAWINGS

- 1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the UTILITY prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.
- 2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
- 3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.
- 4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the CONTRACTOR's other working drawings.

c. PRODUCT DATA

Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

d. SAMPLES

- 1) Furnish, samples required by the Contract Documents for the UTILITY's approval. Samples shall be delivered to the UTILITY as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the UTILITY.
- 2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.

- 3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify Contract Requirements.
- 4) Approved samples not destroyed in testing shall be sent to the UTILITY or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the CONTRACTOR at his expense, if so requested at time of submission.

e. PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

If specifically required in any of the technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section, signed and sealed by the P.E. licensed or registered in the state wherein the work is located.

2. CONTRACTOR'S CERTIFICATION

- a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:

*"Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."*

- b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.
3. The review and approval of shop drawings, working drawings, product data, or samples by the UTILITY shall not relieve the CONTRACTOR from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the CONTRACTOR and the UTILITY will have no responsibility therefor.
4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.
5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation of products or materials that do not conform to approved shop drawings shall be at the CONTRACTOR's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither the UTILITY nor UTILITY will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
6. OPERATION AND MAINTENANCE DATA

Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for UTILITY personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

7. SCHEDULE OF VALUES

On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items into reasonably small components – generally disaggregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the UTILITY, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other mis-distribution of the costs. If, in the opinion of the UTILITY, the schedule of values is unbalanced, CONTRACTOR shall reallocate components to achieve a balanced schedule acceptable to UTILITY.

8. PAYMENT APPLICATION FORMAT

If an application form is included in the **Contract Documents**, use that form unless otherwise approved by the UTILITY. If an application form is not included in the Contract Documents, CONTRACTOR may propose a form for approval.

9. SITE USAGE

Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

G. INFORMATIONAL SUBMITTALS

1. SHOP DRAWING SCHEDULE

Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.

2. CONSTRUCTION SCHEDULE

Prepare and submit construction schedules and monthly status reports as specified.

3. STATEMENTS OF QUALIFICATIONS

Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.

4. HEALTH AND SAFETY PLANS

When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.

5. CONSTRUCTION PHOTOGRAPHY AND VIDEOGRAPHY

Provide periodic construction photographs and videography as specified – including but not limited to preconstruction photographs and/or video, monthly progress photos and/or video and post-construction photographs and/or video.

6. WORK PLANS

Prepare and submit copies of all work plans needed to demonstrate to the UTILITY that CONTRACTOR has adequately thought-out the means and methods of construction and their interface with existing facilities.

7. MAINTENANCE OF TRAFFIC PLANS

Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If CONTRACTOR is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.

8. OUTAGE REQUESTS

Provide sufficient notification of any outages required (electrical, flow processes, etc) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days notice shall be provided.

9. PROPOSED TESTING PROCEDURES

Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.

10. TEST RECORDS AND REPORTS

Provide copies of all test records and reports as specified in the various technical specifications.

11. VENDOR TRAINING OUTLINES/PLANS

At least two weeks before scheduled training of UTILITY's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

12. TEST AND START-UP REPORTS

Manufacturer shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.

13. CERTIFICATIONS



- a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
- b. Certifications may include, but are not limited to:
  - 1) Welding certifications and welders' qualifications
  - 2) Certifications of Installation, Testing and Training for all equipment
  - 3) Material Testing reports furnished by an independent testing firm
  - 4) Certifications from manufacturer(s) for specified factory testing
  - 5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents

14. RECORD DRAWINGS

No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.

15. SUBMITTALS REQUIRED BY LAWS, REGULATIONS AND GOVERNING AGENCIES

Prepare and submit all documentation required by state or local law, regulation, or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to UTILITY one copy of each submittal made in accordance with this paragraph.

16. SUBMITTALS REQUIRED BY FUNDING AGENCIES

Prepare and submit all documentation required by funding agencies. This includes, but is not limited to segregated pay applications and change orders when required to properly allocate funds to different funding sources, and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the UTILITY.

17. OTHER REQUIREMENTS OF THE TECHNICAL SPECIFICATION SECTIONS

Comply with all other requirements of the technical specifications.

18. WARRANTIES AND BONDS

Assemble a book(let) of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds and provide to the UTILITY.

19. AS-BUILT SURVEYS

Engage the services of a licensed land surveyor in accordance with the Project Controls specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

## 20. CONTRACT CLOSE-OUT DOCUMENTS

Submit Contract documentation as indicated in the specification for Contract Close-out.

### PART 2 PRODUCTS (NOT USED)

### PART 3 EXECUTION

#### 3.01 SUBMITTAL SCHEDULE

- A. Provide an initial submittal schedule at the pre-construction meeting for review by UTILITY. Incorporate comments from UTILITY into a revised submittal schedule.
- B. Maintain the submittal schedule and provide sufficient copies for review by UTILITY. An up-to-date submittal schedule shall be provided at each project progress meeting.

#### 3.02 TRANSMITTALS

- A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: The CONTRACTOR's name and address, UTILITY's name, project name, project number, submittal number, description of submittal and number of copies submitted.
- B. Submittals shall be transmitted or delivered directly to the office of the UTILITY, as indicated in the Contact Documents, or as otherwise directed by the UTILITY.
- C. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

#### 3.03 PROCEDURES

##### A. ACTION SUBMITTALS

##### 1. CONTRACTOR'S RESPONSIBILITIES

- a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the CONTRACTOR's failure to transmit submittals sufficiently in advance of the Work.
- b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the UTILITY.
- c. No less than thirty (30) calendar days will be required for UTILITY's review time for shop drawings and O&M manuals involving only one engineering discipline. No less than forty-five (45) calendar days will be required for UTILITY's review time for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review time.
- d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
- e. Before submission to the UTILITY, review shop drawings as follows:

- 1) make corrections and add field measurements, as required
  - 2) use any color for its notations except red (reserved for the UTILITY's notations) and black (to be able to distinguish notations on black and white documents)
  - 3) identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the UTILITY on a previous submission
  - 4) include the required CONTRACTOR's Certification statement
  - 5) provide field measurements (as needed)
  - 6) coordinate with other submittals
  - 7) indicate relationships to other features of the Work
  - 8) highlight information applicable to the Work and/or delete information not applicable to the Work
- f. Submit the following number of copies:
- 1) Shop drawings (including working drawings and product data) – Submit no fewer than six, and no more than nine; five of which will be retained by the UTILITY.
  - 2) Samples – two
  - 3) Site Usage Plan – four copies
  - 4) Schedule of values – four copies
  - 5) Payment application format – four copies
  - 6) Operation and Maintenance Manuals – six copies
- g. If CONTRACTOR considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the UTILITY immediately; and do not release for manufacture before such notice has been received by the UTILITY.
- h. When the shop drawings have been completed to the satisfaction of the UTILITY, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the UTILITY.

## 2. UTILITY'S RESPONSIBILITIES

- a. UTILITY will not review shop drawings (including working drawings and product data) that do not include the CONTRACTOR's approval stamp. Such submittals will be returned to the CONTRACTOR, without action, for correction.
- b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the UTILITY, a submittal is incomplete, that submittal will be returned to the CONTRACTOR for completion. Such submittals may be returned with comments from UTILITY indicating the deficiencies requiring correction.

- c. If shop drawings (including working drawings and product data) meet the submittal requirements, UTILITY will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the CONTRACTOR without action - with the UTILITY retaining one copy.
  - d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the UTILITY within the time specified herein. The time for review will commence upon receipt of submittal by UTILITY.
3. REVIEW OF SHOP DRAWINGS (INCLUDING WORKING DRAWINGS AND PRODUCT DATA) AND SAMPLES
- a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
    - 1) as permitting any departure from the Contract requirements
    - 2) as relieving the CONTRACTOR of responsibility for any errors, including details, dimensions, and materials
    - 3) as approving departures from details furnished by the UTILITY, except as otherwise provided herein
  - b. The CONTRACTOR remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
  - c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the UTILITY are in the interest of the UTILITY and are so minor as not to involve a change in Contract Price or Contract Time, the UTILITY may return the reviewed drawings without noting an exception.
  - d. Only the UTILITY will utilize the color "RED" in marking submittals.
  - e. Shop drawings will be returned to the CONTRACTOR with one of the following codes.
    - Code 1 – "APPROVED" – This code is assigned when there are no notations or comments on the submittal. When returned under this code the CONTRACTOR may release the equipment and/or material for manufacture.
    - Code 2 - "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the CONTRACTOR. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
    - Code 3 - "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is required by the CONTRACTOR. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted.

Confirmation is to be received by the UTILITY within fifteen (15) calendar days of the date of the UTILITY's transmittal requiring the confirmation.

Code 4 - "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the UTILITY within thirty (30) calendar days of the date of the UTILITY's transmittal requiring the resubmittal.

Code 5 – "NOT APPROVED" – This code is assigned when the submittal does not meet the intent of the contract documents. The CONTRACTOR must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the contract documents.

Code 6 – "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the CONTRACTOR.

Code 7 – "RECEIPT ACKNOWLEDGED (Not subject to UTILITY's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the UTILITY's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

- f. REPETITIVE REVIEWS: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the UTILITY's expense. All subsequent reviews will be performed at the CONTRACTOR's expense. Reimburse the UTILITY for all costs invoiced by UTILITY for the third and subsequent reviews.

#### 4. ELECTRONIC TRANSMISSION

- a. ACTION SUBMITTALS may be transmitted by electronic means provided the following conditions are met:
  - 1) The above-specified transmittal form is included.
  - 2) All other requirements specified above have been met including, but not limited to, coordination by the CONTRACTOR, review and approval by the Contactor, and the CONTRACTOR's Certification.
  - 3) With the exception of the transmittal sheet, the entire submittal is included in a single file.
  - 4) The electronic files are PDF format (with printing enabled).
  - 5) In addition, transmit three hard-copy (paper) originals to the UTILITY.
  - 6) For Submittals that require certification, corporate seal, or professional embossment (i.e. P.E.s, Surveyors, etc) transmit at least two hard-copy originals to the UTILITY. In addition, provide additional photocopied or scanned copies, as

specified above, showing the required certification, corporate seal, or professional seal.

B. INFORMATIONAL SUBMITTALS

1. CONTRACTOR'S RESPONSIBILITIES

- a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections
- b. Refer to individual technical Specification Sections for specific submittal requirements.

2. UTILITY'S RESPONSIBILITIES

- a. The UTILITY will review each informational submittal within fifteen (15) days. If the informational submittal complies with the Contract requirements, UTILITY will file for the project record. UTILITY may elect not to respond to CONTRACTOR regarding informational submittals meeting the Contract requirements.
- b. If an informational submittal does not comply with the Contract requirements, UTILITY will respond accordingly to the CONTRACTOR within fifteen (15) days. Thereafter, the CONTRACTOR shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the UTILITY, is in conformance with the Contract Documents.

3. ELECTRONIC TRANSMISSION

- a. INFORMATIONAL SUBMITTALS may be transmitted by electronic means providing all of the following conditions are met:
  - 1) The above-specified transmittal form is included.
  - 2) With the exception of the transmittal sheet, the entire submittal is included in a single file.
  - 3) The electronic files are PDF format (printing enabled).
  - 4) For Submittals that require certification, corporate seal, or professional embossment (i.e. P.E.s, Surveyors, etc)) transmit two hard-copy originals to the UTILITY.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the [State] [Commonwealth] of \_\_\_\_\_ and that he/she has been employed by

\_\_\_\_\_ to  
design

(Name of CONTRACTOR)

\_\_\_\_\_  
— (Insert P.E. Responsibilities)

In accordance with Specification Section \_\_\_\_\_  
for the

\_\_\_\_\_  
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the City of Blytheville Water and Sewer Utility or their authorized representative, within seven days following written request therefor by the UTILITY.

\_\_\_\_\_  
P.E. Name CONTRACTOR's Name

\_\_\_\_\_  
Signature Signature

\_\_\_\_\_  
Address Title

\_\_\_\_\_  
Address





SECTION 01 3119  
PROJECT MEETINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The Engineer shall schedule and administer a pre-construction meeting, periodic progress meetings and specially called meetings throughout progress of the work.
  - 1. Prepare agenda for meetings.
  - 2. Make physical arrangements for meetings.
  - 3. Preside at meetings.
  - 4. Record the minutes; include significant proceedings and decisions.
  - 5. Reproduce and distribute copies of minutes within 10 working days after each meeting.
    - a. To participants in the meeting.
    - b. To parties affected by decisions made at the meeting.
- B. Representatives of Contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. Attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.02 RELATED REQUIREMENTS

- A. Instructions to Bidders are included in Division 0.
- B. Submittals are included in Section 01\_3000.
- D. Project Record Documents are included in Section 01\_7839.
- E. Operating and Maintenance Data is included in Section 01\_8823.

1.03 PRE-CONSTRUCTION MEETING

- A. Schedule a preconstruction meeting no later than ten (10) days after date of Notice to Proceed.
- B. Location: A central site, convenient for all parties, designated by the Owner.
- C. Attendance
  - 1. OWNER Representative.
  - 2. Engineer and his/her professional consultants.
  - 3. Resident Project Representative.
  - 4. Contractor's Superintendent.

5. Major Subcontractors.
6. Major suppliers.
7. Utility Companies
8. Others as appropriate.

D. Suggested Agenda

1. Distribution and discussion of:
  - a. List of major subcontractors and suppliers.
  - b. Projected Construction Schedules.
2. Critical work sequencing.
3. Major equipment deliveries and priorities.
4. Project Coordination.
  - a. Designation of responsible personnel.
5. Procedures and processing of:
  - a. Field decisions.
  - b. Proposal requests.
  - c. Submittals.
  - d. Change Orders.
  - e. Applications for Payment.
6. Adequacy of distribution of Contract Documents.
7. Procedures for maintaining Record Documents.
8. Use of premises:
  - a. Office, work, and storage areas.
  - b. Owner's requirements.
9. Construction facilities, controls, and construction aids.
10. Temporary utilities.
11. Housekeeping procedures.

1.04 PROGRESS MEETINGS

- A. Schedule regular periodic meetings. The progress meetings will be held every week with the first meeting no later than 11 calendar days after the pre-construction meeting.

- B. Hold called meetings as required by progress of the work.
- C. Location of the meetings: Project field office of Contractor or Engineer.
- D. Attendance
  - 1. Engineer and his/her professional consultants as needed.
  - 2. Contractor's Superintendent
  - 3. Subcontractors as appropriate to the agenda.
  - 4. Suppliers as appropriate to the agenda. For suppliers, a call-in to the meeting will be acceptable unless physical presence is required.
  - 5. Others as appropriate.
- E. Suggested Agenda
  - 1. Review, approval of minutes of previous meeting.
  - 2. Review of work progress since previous meeting.
  - 3. Field observations, problems, and conflicts.
  - 4. Problems which impede Construction Schedule.
  - 5. Review of off-site fabrication, delivery schedules.
  - 6. Corrective measures and procedures to regain projected schedule.
  - 7. Revisions to Construction Schedule.
  - 8. Progress, schedule, during succeeding work period.
  - 9. Coordination of schedules.
  - 10. Review submittal schedules; expedite as required.
  - 11. Maintenance of quality standards.
  - 12. Pending changes and substitutions.
  - 13. Review proposed changes for:
    - a. Effect on Construction Schedule and on completion date.
    - b. Effect on other contracts of the project.
  - 14. Other business.
  - 15. Construction schedule.
  - 16. Critical/long lead items.
- F. Attend progress meetings and is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the work, etc.

G. Provide a current submittal log at each progress meeting in accordance with Section 013000.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

## SECTION 01 4527

### EQUIPMENT TESTING AND STARTUP

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Provide a competent field services technician of the manufacturers of all equipment furnished, to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.
- B. Perform specified equipment field performance tests, final acceptance tests and startup services.

##### 1.02 RELATED WORK

- A. Operation and Maintenance Data is included in Section 01 8823.
- B. Performance and acceptance testing and startup requirements are included in the respective sections of the equipment specifications.

##### 1.03 SUBMITTALS

- A. Submit name, address and resume' of proposed field services technicians at least 30 days in advance of the need for such services.
- B. Submit, in accordance with Section 01\_3000, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:
  - 1. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:
    - a. Name of equipment to be tested, including reference to specifications section number and title.
    - b. Testing schedule of proposed dates and times for testing.
    - c. Summary of power, lighting, chemical, water, sludge, gas, etc, needs and identification of who will provide them.
    - d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
    - e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc).
    - f. Samples of forms to be used to collect and record test data and to present tabulated test results.
  - 2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect actual conduct of the tests and the following additional information:

- a. Copy of all test data sheets and results of lab analyses.
  - b. Summary comparison of specified test and performance requirements vs actual test results.
  - c. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing the equipment.
3. Copies of the manufacturer's field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified herein.

#### 1.04 REFERENCE STANDARDS

- A. American Water Works Association (AWWA)
  1. AWWA C653 - Disinfection for Water Treatment Plants.
- B. American Society for Testing and Materials (ASTM)
- C. Water Pollution Control Federation (WPCF)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.05 QUALITY ASSURANCE

- A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.
- B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians.

### PART 2 PRODUCTS (NOT USED)

### PART 3 EXECUTION

#### 3.01 PRELIMINARY REQUIREMENTS

- A. After installation of the equipment has been completed and the equipment is presumably ready for operation, before it is operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:
  1. Soundness (without crack or otherwise damaged parts).
  2. Completeness in all details, as specified and required.
  3. Correctness of setting, alignment, and relative arrangement of various parts.
  4. Adequacy and correctness of packing, sealing and lubricants.
- B. The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

- C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments, and tests.

3.02 WITNESS REQUIREMENTS

- A. Shop tests or factory tests may be witnessed by the Owner and/or Owner's representatives, as required by the various equipment specifications.
- B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designed personnel and/or Owner's representatives.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner \_\_\_\_\_

Project \_\_\_\_\_

Contract No. \_\_\_\_\_

EQUIPMENT SPECIFICATION SECTION \_\_\_\_\_

EQUIPMENT DESCRIPTION \_\_\_\_\_

I \_\_\_\_\_, Authorized representative  
of  
(Print Name)

\_\_\_\_\_  
(Print Manufacturer's Name)

hereby CERTIFY that

\_\_\_\_\_  
(Print equipment name and model with serial no.)

\_\_\_\_\_

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date \_\_\_\_\_

Time \_\_\_\_\_

CERTIFIED BY: \_\_\_\_\_  
(Signature of Manufacturer's Representative)

Date: \_\_\_\_\_

END OF SECTION



SECTION 015000  
TEMPORARY FACILITIES

1. GENERAL

1.01 TEMPORARY SANITARY FACILITIES

- A. Sanitary facilities will not be provided by owner. Contractor shall provide on-site facilities or use portable facilities at Contractor's expense. Portable facilities shall be located as directed by Engineer, Owner, or Representatives of Engineer/Owner and serviced and cleaned regularly.

1.02 PROTECTION OF INSTALLED WORK

- A. Contractor is responsible for providing temporary and removable protection for installed products.

1.03 TEMPORARY ACCESS AND PARKING

- A. Contractor shall provide adequate temporary access to working areas as approved by Owner/Engineer.
- B. Contractor shall not park any vehicles on any street or private property without permission from the Owner.

1.04 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

1.05 REMOVAL OF FACILITIES AND FINAL CLEANUP

- A. Remove all equipment, facilities, and materials prior to final inspection.
- B. Restore existing facilities and area used during construction to original condition.

1.06 STAGING AREA/MATERIALS STORED

- A. Contractor shall be responsible for locating a site for materials stored, equipment, and staging area for construction.
- B. Contractor shall provide owner written documentation between property owner and contractor as to the agreement to utilize property for staging area.

1.07 TRAFFIC CONTROL

- A. Contractor shall submit a barricade and traffic control plan to the public works director for approval.
- B. Contractor shall be responsible for implementing barricade plan, flagging, signage, and traffic flow.

END OF SECTION 015000



SECTION 015700

DUST CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Perform dust control operations, in an approved manner, whenever necessary or when directed by the Engineer, even though other work on the project may be suspended. Dust control shall be generally accomplished by the use of water; however, the use of calcium chloride may be used when necessary to control dust nuisance.
- B. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.
- C. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION



## SECTION 015713

### TEMPORARY EROSION AND SEDIMENT CONTROL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. In all respects during prosecution of the Work called for by the Contract Documents, Contractor shall minimize the discharge of stormwater pollutants from the construction activity.
- B. The work shall be so planned and executed so as to prevent siltation of area streams, ditches, swales, and drainages. Barriers, silt fences and filters shall be constructed as necessary by the Contractor to intercept and impede silt or debris laden runoff from the construction site and prevent excessive quantities of silt and debris from reaching area streams and drainages.
- C. Barriers and filters shall be constructed as necessary by the Contractor to intercept and impede silt or debris laden runoff from the construction site and prevent excessive quantities of silt and debris from reaching area streams and drainages.
- D. The Contractor shall complete, for the Owner, all Storm Water Permit forms, as necessary and as required by the Arkansas Department of Environmental Quality (ADEQ), and send to the Engineer for Owner signature and forwarding to ADEQ. The Contractor shall be responsible for any and all fees, notices, notice of intent, notice of termination, disclosure statements, storm water pollution prevention plan, etc. associated with obtaining the Storm Water Permit. The Contractor shall prepare the Storm Water Pollution Prevention Plan (SWPPP), as required, for the project in accordance with Arkansas Department of Environmental Quality (ADEQ) regulations. The Contractor shall submit all forms and the SWPPP, as required, to the Engineer for Owner signature and forwarding to ADEQ.
- E. If the disturbed area is less than 1 acre, the Notice of Coverage (NOC) and the SWPPP are not required. The Contractor shall prepare a drawing showing location and details of silt fences, barriers, etc. that the Contractor plans to install. The Contractor shall give the drawing to the Owner and Engineer for review. The Contractor shall follow Best Management Practices (BMP's) in accordance with ADEQ requirements.
- F. Permit and other required documents to be in the name of the Owner.
- G. The Contractor shall be responsible for implementing the SWPPP (if a SWPPP is required by ADEQ) and/or runoff control measures including maintenance of the SWPPP, maintenance of control features, conducting inspections, implementing best management practices, site posting, and responsible for plan amendments. Contractor shall be responsible for the cost of all claims, losses, fines, penalties, or damages charged to Owner or Engineer due to Contractor's failure to comply with the requirements of the NPDES Storm Water Permit.
- H. Contractor shall, on Owner/Operator's behalf, execute all applicable requirements and discharge all duties as may be required for this project as described in ADEQ issued Construction General Permit titled "Authorization to Discharge Stormwater Under the National Pollutant Discharge Elimination system and the Arkansas Water and Air Pollution Control Act" including, but not limited to:

1. Complete and post the NOC using forms acceptable to ADEQ;
  2. Timely preparation of the SWPPP, using a format acceptable to ADEQ;
  3. Ensuring that the site is in compliance with any changes or updates of the Permit;
  4. Select, install, implement, and maintain best management practices at the construction site that minimize pollutants in stormwater discharges so as to meet applicable water quality standards;
  5. Provide qualified personnel to conduct inspections and prepare inspection reports;
  6. Maintain a file on site containing documents required by the SWPPP;
  7. Achieve final stabilization;
  8. Prepare and submit the NOT;
  9. Execute other requirements as may be required by ADEQ and the Permit.
  10. The Contractor shall be responsible for all fees, notices, notice of intent, notice of termination, disclosure statements, etc. associated with obtaining the Storm Water Permit.
- I. The Contractor shall not begin construction before the Notice of Coverage (NOC) and SWPPP is posted at the construction site. According to current ADEQ regulations, if the disturbed area is less than 1 acre the NOC and SWPPP are not required. If the disturbed area will be less than one acre, the Contractor shall submit a letter to the Owner stating such. The Contractor shall be required to use Best Management Practices if the disturbed area is less than one acre.
- J. All costs pertaining to items specified in this section shall be at the expense of the Contractor.

## 1.2 SECTION INCLUDES

- A. Temporary measures required to control erosion and sediment during construction. This includes measures to meet the requirements of the NPDES administered by the Environmental Protection Agency and the Arkansas Department of Environmental Quality, including but not limited to:
1. Temporary hay bale dikes;
  2. Stabilized construction entrance;
  3. Silt fence;
  4. Rock Check/Sand Bag Dams and/or Velocity Dissipation Devices;
  5. Storm Water Pollution Prevention Plan (SWPPP).

## 1.3 SUBMITTALS

- A. Submit in accordance with Section 013300 - Submittals. Submit only on items required by the work.
- B. Submit the SWPPP, if required.
- C. Product Data:
1. Provide storm water prevention measures for compliance with approved and appropriately maintained SWPPP.
    - a. Hay Bales
    - b. Silt Fences
    - c. Sand Bag Ditch Checks
    - d. Rock Ditch Checks

- e. Sediment Basins
  - f. Rock Check Outlet Structures
  - g. Temporary Seeding Stabilization
  - h. Filter Fabric
  - i. Other approved SWPPP control measures as approved by ADEQ
2. Non-woven filter fabric
- a. Inspection Reports and Certificates:
  - b. Submit periodic inspection reports and certificates required for SWPPP.
  - c. Submit Contractor/Subcontractor certifications required for SWPPP.
- D. Submit revisions or modifications to the erosion and sediment control plan and SWPPP.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hay bales shall weigh a minimum of fifty (50) pounds and shall be at least thirty (30) inches in length. Bales shall be composed entirely of vegetable matter and be free of seeds. Binding shall be either wire or nylon string, jute or cotton binding is unacceptable. Bales shall be used for not more than two months before being replaced. However, if weather conditions cause biological degradation of the hay bales, they shall be replaced sooner than the two-month time period to prevent a loss of structural integrity of the hay bale dike.
- B. Stone material shall consist of rip-rap conforming to Arkansas Department of Transportation Standard Specifications and shall be placed as shown or in a layer of at least 12 inches thick.
- C. Geotextile Fabrics shall be a non-woven polypropylene fabric designed specifically for use as a soil filtration media. Fabric shall have an approximate weight of 6 oz/yd<sup>2</sup>, and shall conform to the following:

<u>Designation</u>	<u>Topic</u>	<u>Value</u>
ASTM D4632	Grab Strength (lbs.)	200
ASTM D4632	Grab Elongation	15%
ASTM D4533	Trapezoidal Tear (lbs.)	50
ASTM D751	Burst (psi)	320
ASTM D751	Puncture (psi)	80

ASTM D4751 Equivalent Opening Size (EOS) (mm)-soil retention.

<u>For Soils in Which:</u>	<u>EOS:</u>
50% or less passes a #200 mesh sieve	Greater than a #30 sieve
More than 50% passes a #200 mesh sieve	Greater than a #50 sieve

ASTM D4491 Permeability (k):

<u>For Soils in Which:</u>	<u>EOS:</u>
Critical/Severe:	k (fabric) >10k (soil)
Normal Applications:	k (fabric) >k (soil)

- D. Geotextile Silt Fence Fabric shall be a nylon reinforced polypropylene fabric having a reinforcing cord running the entire length to the top edge of the fabric. The fabric must meet or exceed the following criteria:

<u>Test Designation</u>	<u>Topic</u>	<u>Average Roll Minimum Value</u>
ASTM D4632	Grab Strength (lbs.)	90 lbs. @ 12"/minute
ASTM D4632	Grab Elongation	15% @ 12"/minute
ASTM D4751	Equivalent Opening Size (EOS)	U.S. sieve No. 20
ASTM D4491	Permittivity	>.01 sec.-1
ASTM D4355	U.V Resistance (500 hours exposure)	70%

- E. Fence Posts for Silt Fence shall be steel "T" posts of sufficient length to support the silt fence system.
- F. Woven Wire Support for Silt Fence: W1.4, 4" x 4", zinc coated (galvanized) steel woven wire fabric conforming to ASTM A116.
- G. Corrugated Metal Pipe: 16-gauge helical wound galvanized corrugated metal pipe.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION AND PREPARATION

- A. Prepare SWPPP on behalf of the Owner as required by ADEQ. The Contractor shall be responsible for reading and being thoroughly familiar with the permit and the storm water pollution prevention plan (SWPPP).
- B. The Contractor shall follow all requirements of ADEQ Short Term Activity Authorizations and Corps of Engineers Permits.
- C. Locate and protect survey horizontal and vertical control.
- D. Contractor shall install silt fencing as necessary to prevent siltation of area streams, ditches, swales, and drainages.

#### 3.2 MAINTENANCE

- A. Maintain erosion control devices as necessary to comply with the NPDES Storm Water Permit and Pollution Prevention Plan. This includes any revisions or modifications to the SWPPP. Any work required for modifications, revisions, and maintenance shall be the responsibility of the Contractor and shall not be a basis for additional compensation.
- B. Maintain existing erosion and sedimentation control systems located within the project site.
- C. Inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials off site.
- D. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.



- E. Remove and dispose of sediment deposits. Offsite disposal will be the responsibility of the Contractor. Sediment to be placed at the project site shall be spread, compacted and stabilized in accordance with the Owner's directions. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.
- F. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum 8-inch lifts. Compaction density shall be at a minimum of 90 percent Standard Proctor ASTM D-698 density. Protect embankments from erosion by grassing or other Owner approved methods.

### 3.3 TEMPORARY HAY BALE DIKE

- A. Install where shown or as needed for erosion control.
- B. Hay bales shall be embedded a minimum of four (4) inches and securely anchored using 3/8-inch diameter steel stakes or 2" x 2" wood stakes driven through the bales into the ground a minimum of six (6) inches. Hay bales are to be placed directly adjacent to one another leaving no gap between them.

### 3.4 CONSTRUCTION ENTRANCE

- A. When necessary, wheels must be cleaned to remove sediment prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with crushed stone (Type "A" rip-rap) which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse using approved methods.

### 3.5 SILT FENCE

- A. Silt fences shall be constructed as needed and as required by the NPDES permit to prevent siltation of area streams, ditches, swales, and drainages.
- B. Silt fence shall consist of nylon reinforced polypropylene netting supported by woven wire mesh, W1.4 x W1.4 and galvanized steel posts set a minimum depth of 2 feet and spaced not more than 6 feet on center. A 6-inch wide trench is to be cut 8 inches deep at the toe of the fence on the uphill side to allow the fabric to be laid below the surface and backfilled. Fabric shall overlap at abutting ends a minimum of 3 feet, and shall be joined such that no leakage or bypass occurs. Remove accumulated sediment when the depth reaches 6 inches.

### 3.6 ROCK CHECK/ SAND BAG CHECK DAM

- A. Rock Check/Sand Bag Dams shall be constructed as needed and as required by the NPDES permit to reduce velocity in channels. Geotextile fabric shall be placed beneath the rock and shall conform to these specifications.

### 3.7 SEDIMENT BASIN WITH STONE AND PIPE OUTLET

- A. Provide sediment basins as needed and as required by the NPDES permit at locations as needed by Contractor's construction sequence and operations.
- B. Install stone and pipe outlets for sediment basin at location shown and/or located as needed by Contractor's construction sequence and as required by the NPDES permit.

- C. Inspect sediment basin after each rainfall, daily during periods of prolonged rainfall, and a minimum of once a week. Maintain basin dimensions necessary to obtain the needed basin volume. Repair and replace damaged components of the basin.

### 3.8 DIVERSION DIKE

- A. Diversion dikes shall be installed prior to and maintained for the duration of construction and shall intercept no more than five (5) acres of runoff. Dikes shall have a minimum top width of 2 feet and a minimum height of compacted fill of 18" measured from the top of the existing ground at the up-slope toe to top of the dike and having side slopes of 3:1 or flatter. The channel which is formed by the dike must have a minimum slope of one (1) percent for the entire length to an outlet. When the slope exceeds three (3) percent, or velocities exceed one foot per second (regardless of slope), stone stabilization is required. Plant grass on dikes not requiring stone stabilization.

### 3.9 STORM WATER POLLUTION PREVENTION PLAN (SWPPP) – AS REQUIRED

- A. Contractor's SWPPP shall conform with requirements of Arkansas Department of Environmental Quality.

### 3.10 NOTICE OF INTENT (NOI), NOTICE OF TERMINATION (NOT) – AS REQUIRED

- A. Contractor shall submit a Notice of Intent (NOI) at least 48 hours prior to the start of construction.
- B. Contractor shall submit a Notice of Termination (NOT) as required by the NPDES regulations.

END OF SECTION

## SECTION 016400

### SUPPORTS, HANGERS, AND ANCHORS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Section includes specifications, guidance, and references for furnishing and installing supports, hangers, bases, and anchors for mechanical, electrical, and miscellaneous work, as required by this project. The required supports and or anchors for the work, includes, but is not limited to, the following:
  - 1. Pipe and Associated Appurtenances - Hangers, Anchors, and Supports.
  - 2. Equipment and Associated Appurtenances - Bases, Anchors, and Supports.
  - 3. Sleeves and Seals.
  - 4. Flashing/Sealing Equipment and Pipe Stacks.
  - 5. Duct Hangers and Supports.
- B. All costs in connection with the Work specified herein will be considered to be included or incidental to the Work of this Contract.

##### 1.2 RELATED SECTIONS

- A. Section 013300 – Submittal Procedures
- B. Section 055000 – Miscellaneous Steel Fabrications
- C. Section 220010 – Basic Mechanical Requirements
- D. Section 220060 – Pipe and Pipe Fittings
- E. Section 089113 – Louvers
- F. Section 233113 – Metal Ductwork
- G. Section 017400 – Vibration Isolation and Seismic Control for Equipment
- H. Division 33 – Water/Wastewater Equipment and Piping

##### 1.3 REFERENCES AND REGULATORY REQUIREMENTS

- A. General:
  - 1. The publications and agencies listed below form a part of this section to extent referenced.
  - 2. Referenced standards shall be of the latest edition available or the adopted edition, on the date of the Bids, unless a specific date is listed in regard to an adopted code or regulation.
  - 3. Auxiliary Steel: Design in accordance with AISC Handbook.
  - 4. ASA Code for Pressure Piping
  - 5. CID A-A-1192A
- B. In addition to the referenced standards, the regulatory requirements that govern the work of this section include the following Codes for the State of Arkansas and in

particular, The City of Walnut Ridge, Arkansas. Adopted codes as follows:

1. 2012 Arkansas Fire Prevention Code (including Arkansas amendments)
  2. 2014 National Electrical Code
  3. 2010 Arkansas Mechanical Code
  4. 2006 Arkansas Plumbing Code
  5. 2006 Arkansas Fuel Gas Code
- C. Arkansas Department of Finance and Administration – Division of Building Authority (DBA).
- D. International Code Council (ICC)
- E. ASME International (ASME):
1. ASME B18.2.1 Square and Hex Bolts and Screws (Inch Series).
  2. ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
  3. ASME B31.1 Power Piping.
- F. ASTM International (ASTM):
1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  2. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  3. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  4. ASTM A36 Standard Specification for Carbon Structural Steel.
  5. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  6. ASTM A276 Standard Specification for Stainless Bars and Shapes.
  7. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  8. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  9. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.
  10. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium Vanadium Structural Steel.
  11. ASTM A603 Standard Specification for Zinc-Coated Steel Structural Wire Rope.
  12. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  13. ASTM A555 Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods.
  14. ASTM A582 Standard Specification for Free-Machining Stainless Steel Bars.
  15. ASTM A967 Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
  16. ASTM F594 Standard Specification for Stainless Steel Nuts.
  17. ASTM A492 Standard Specification for Stainless Steel Rope Wire.
  18. ASTM A493 Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
  19. ASTM E488 Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
  20. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe

- Hangers.
21. ASTM E3121 Standard Test Methods for Field Testing of Anchors in Concrete or Masonry.
  22. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

G. American National Standards Institute/Manufacturers Standardized Society (ANSI/MSS):

1. SP-58 Pipe Hangers and Supports – Materials, Design, Manufacturer, Selection, Application, and Installation.
2. SP-69 Pipe Hangers and Supports – Selection and Application.
3. SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices.

#### 1.4 SUBMITTALS

- A. Refer to Section 013300 – Submittal Procedures for requirements.
- B. Submit shop drawings and manufacturer's product data of all supports, hangers, bases, and anchor devices. Include installation locations, load capacity, and description of materials and parts.
- C. All equipment with an operating weight of 400 pounds or more shall have base, support, and anchorage calculations prepared and stamped by a registered structural or civil engineer in the State of Arkansas in accordance with this section. The Contractor shall submit required calculations and shop drawings of support/anchor layout and details, including plans showing location of equipment on concrete pad and distances from edge of concrete to anchor bolts and embedment depth.
- D. Layout of the Work being supported, hung, anchored, or secured shall include dimensions and details, and such systems shall be shown on the drawings as be verified by the Contractor for agreement with manufacturer's information and shop drawings.
  1. If the Contractor desires to revise the layout or details shown on the drawings, the Contractor shall prepare detailed submittal drawings of the desired revision to be approved by the Engineer. The Contractor's submittal shall include the necessary detailed drawings and design calculations prepared and stamped by a civil or structural engineer currently registered in the State of Arkansas, as required herein.
  2. The structural calculations and details of the proposed support/anchor system shall be included in the submittal for the associated equipment, as required herein.
  3. Where calculations provided by the Contractor's licensed engineer require changes to equipment pads/foundation/equipment skids (size, shape, depth, material), supports, hangers, and/or anchors in order to be sufficient per the calculations, the Contractor shall confirm that such modifications shall not impact or interfere with other portions of the facility and shall bring the modifications to the attention of the Engineer. Contractor shall provide all necessary materials, labor, and equipment to construct the approved and modified base and other changes as required to accommodate the calculation requirements at no additional cost to the Owner.

## 1.5 SYSTEM DESCRIPTION

- A. Provide adequate pipe, duct, stack, and equipment foundation and suspension system in accordance with recognized engineering practices, using, where possible, standard commercial support systems and accessories, as appropriate for the application.
- B. Where thermal movement will occur, provide pipe hanger assembly capable of supporting the pipe hanger throughout the range of operating temperature.

## 1.6 DESIGN AND SELECTION CRITERIA

- A. All support, hangers, anchors, equipment pads, or other such systems to be furnished by the Contractor shall be designed to adequately resist static loading as well as loading due to system operations, and vertical and lateral dynamic forces, including those imposed by wind or seismic events.
  - 1. Determine the force at each hanger, support, or anchor, to prevent overstressing the pipe or connected equipment.
- B. Unless otherwise specified, all support, hanger, anchor, equipment pads, or other such systems shall be designed and installed to resist seismic and wind forces, as required by building code. Equipment anchorage, pipe support, mechanical support and anchorages, and other such required system shall be determined in accordance with required building code requirements for the minimum design and other criteria specific to the application. The minimum seismic lateral force in the direction of each principal horizontal axis shall use the required building code with an Importance Factor of 1.5.
  - 1. Wind loading shall be determined using a minimum basic wind speed of 80 mph, Exposure C, Importance Factor of 1.15.
  - 2. Allowable Stress Design shall be used for all calculations, except for the design of cast-in anchor bolts.
  - 3. Calculations shall include the following steps as a minimum:
    - a. Determination of the operating weight and centroid of the equipment.
    - b. Determination of the shear and overturning forces at each anchor/hanger/support/base due to the force determined, as specified herein, being applied at the applications centroid.
    - c. Determination of the shear and tension forces which must be developed by the anchor at each support/hanger/base to resist the forces calculated.
    - d. Selection of details of anchor, hanger, support, or equipment foundation system shall be based upon the maximum shear and tension forces calculated above. As a minimum, detail shall include number of bolts, materials, diameter, total length, embedded length, required edge distance, projection of anchor, and bolt dimensions.
    - e. All shall be designed for the forces which produce the most critical conditions. In addition to the seismic lateral force, all shall be designed to resist a vertical force equal to 80 percent of the horizontal seismic force. The design of cast-in anchor bolts shall be in accordance with the appropriate sections of the required building code. The design of expansion or adhesive anchors shall be in accordance with the applicable ICC Evaluation Report. Design shall be based on installation in concrete with a 28-day compressive strength of 3,000 psi.

4. Anchorage, support, hangers, bases, and other such systems shall be designed to resist lateral seismic forces occurring at each of the two principal horizontal directions of the application, separately as well as simultaneously. When combining seismic forces in orthogonal directions simultaneously, the square root of the sum of the squares (SRSS) basis using 100 percent of the forces in both directions shall be used. Where inclusion of vertical loads results in a less conservative design, vertical effects shall be neglected.
5. Do not use friction to resist sliding due to seismic or wind forces.
6. All adhesive and expansion anchors shall have current ICC Evaluation Reports. No expansion anchors shall be used in tension.
7. No equipment shall be anchored to vertical structural elements without approval of the Engineer, except pipe hangers, supports, or anchorage as specified.

## PART 2 - PRODUCTS

- A. Anchors of all types, together with their nuts, washers, and sleeves, located in or above any wetted water-containing structure, channel, or chemical containment area, shall be Type 316 stainless steel. All other anchors (with nuts, washers, and sleeves) shall be galvanized or zinc coated after threading by the hot-dip process in conformity with ASTM A153.
- B. For all equipment weighing 400 pounds (181 kilograms) or more, the minimum anchor bolt (including chemical anchor bolt) diameter shall be 5/8-inch. The minimum anchor bolt for all other equipment shall be 3/8-inch.
- C. All pipe hangers and supports shall be of stainless steel construction or of carbon steel manufactured of the same grade and quality to match existing supports.
- D. Hangers and supports, according to applicable installation conditions, shall be as follows:
  1. Hangers: Stainless steel (malleable iron where allowed), adjustable swivel, split ring for pipe sizes 1-1/2" to 2".
  2. Hangers: Stainless steel (carbon steel where allowable), adjustable, clevis for pipe size over 2".
  3. Multiple or Trapeze Hangers: Stainless steel channels with welded spacers and hanger rods. Stainless steel (cast iron where allowable) roll and stand for hot pipe sizes 6 inches and over.
  4. Wall Support: Stainless steel hook for pipe size 3" and less.
  5. Wall Support: Welded stainless steel bracket and steel clamp for pipe size 4" and over.
  6. Vertical Support: Stainless steel riser clamp.
  7. Floor Support: Stainless steel adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  8. Copper Pipe Support: Stainless steel ring, adjustable, copper plated or synthetic insert. Uninsulated Copper 2" and Less, provide two-hole pipe strap. Insulated Copper 2" and Less, provide adjustable clevis or ring hanger, provide protection shield at each hanger.
  9. Hanger Rods: Stainless steel threaded both ends, threaded one end, or continuous thread. Connections to threaded rods shall be double nutted.
  10. Wedge type, Type 316 stainless steel, expansion bolts.
  11. Refrigerant lines: clevis hangers, wire pipe hook, or galvanized perforated hanger strapping. On insulated lines, provide protection shield at each hanger.

12. Ductile and Cast Iron Pipe: Provide clevis hanger. For insulated pipes, provide protection shield at each hanger. Provide adjustable saddle supports, as required.
  13. Floor Support (Pipe over 3"): Adjustable, stainless steel, pipe roll and stand, stainless steel screws, and concrete pier or steel support.
- E. Inserts, shall be as follows, depending on the application: Galvanized steel shell or stainless-steel shell, and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms. Size inserts to suit threaded hanger rods. Provide beam clamps.
  - F. Metal Flashings shall be gauge 26-stainless steel (unless specified otherwise, then galvanized). Caps shall be 22-gage minimum; use 16-gage at fire resistant elements.
  - G. Metal Counter Flashing shall be 22-gauge stainless steel.
  - H. Lead Flashings shall be as follows:
    1. Waterproofing: 5 lbs/sq. ft. sheet lead
    2. Soundproofing: 1 lbs/sq. ft. sheet lead
  - I. Flexible Flashing shall be 47-mil thick sheet butyl.
  - J. Anchors and Bolts: Bolts and studs, nuts, and washers shall be Type 316 stainless-steel where installed in any location or application where corrosion is of concern. Stainless steel Type 316 shall be used for all anchoring, supporting, or securing of equipment and such, installed at or near sewer-structures, collection, treatment, or otherwise, or where specifically directed by the Engineer or herein.
  - K. Fasteners and Accessories of Systems, specified herein: Provide anchors, supports, hangers, and fasteners, washers, straps, and accessories required for a complete and finished installation. Fasteners shall be Type 316 stainless-steel.
  - L. Expansion Bolts: where not included in concrete or masonry installations or construction, shall be Type 316 stainless-steel screws or bolts with expansion-shield type for concrete or masonry, of sizes and types indicated or required.
  - M. Braces and supports shall consist of components specifically designed for the intended service, galvanized (except pipe hanger in contact with copper pipe or where elsewhere specified) and complete with galvanized pipe chord member.
  - N. The use of wire, rope, straps, chain, wood, or similar make-shift devise is prohibited. The use of restraint systems is prohibited.
  - O. Pipe Hangers, supports, and other accessories shall be by Anvil International, Empire Industries, Inc., or approved equal.
  - P. Furnish fabricate pipe racks and trapeze hangers from adequately sized Unistrut clamps and accessories. Furnish welded steel brackets.



## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Select hangers, supports, anchors, and miscellaneous bases/supports recommended by equipment manufacturer in accordance with the standard specifications for selection, fabrication, and design as referenced herein.
- B. Install support, hanger, and/or anchor system in accordance with equipment manufacturers instructions.
- C. Install systems complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide all bolt heads and nuts with washers.
- D. For pipe subject to longitudinal movement, provide appropriate pipe roller. For pipe subject to vertical movement, provide spring cushion hangers. Provide pipe covering protection saddle at each support point.
- E. For insulated ductile and cast iron pipe, provide protection shield at each hanger.
- F. Saddle supports shall be accessible.
- G. All pipes, both horizontal and vertical, shall be adequately supported from the building structural members. Each hanger shall be properly sized to fit supported pipe.
- H. Unless otherwise indicated perforated strap or wire will not be acceptable as hanger or fastening.
- I. Do not support piping or equipment from ceilings or ceiling support systems.
- J. Coordinate installation of supporting devices with other work. Arrange for grouping of parallel runs of horizontal pipes to be supported together on trapeze type hangers where possible.
- K. Where small pipes are supported under bar joists, hanger rods may be extended through the space between the bottom angles and secured with a washer and two nuts.
- L. Where larger pipes are supported beneath bar joist, hanger rods shall be secured to angle irons of adequate size. Each angle iron shall span across two or more joists, as required, to distribute the weight effectively. Anchor these angle irons to the joist.
- M. Where pipes are supported under exposed steel beams, approved type beam clamps shall be used.

### 3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into, and ground flush, with slab (for exposed slabs).
- F. Drilling and anchoring systems such as by Ramset may be used for support of miscellaneous pipe and duct work in existing concrete.
- G. Provide concrete inserts where mechanical equipment, pipes and pipe racks are supported from concrete. Install concrete inserts during placing of concrete at appropriate intervals and location.

### 3.3 PLACEMENT OF ANCHORS, HANGERS, AND SUPPORTS

- A. Install all anchorage, hanger, and support devices where indicated or required.
- B. Install hangers to provide a minimum 2-inches between finished covering and adjacent work.
- C. Support horizontal and vertical piping as scheduled:

Pipe Size	Max. Hanger Spacing	Hanger Diameter
1/2" to 1-1/4"	6'-6"	3/8"
1-1/2" to 2"	10'-0"	3/8"
2-1/2" to 3"	10'-0"	1/2"
4" to 6"	10'-0"	5/8"
8" to 12"	14'-0"	7/8"
14" and Over	14'-0"	1"
PVC (All Sizes)	6'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at Joints	

- D. Place hangers within 12-inches of each horizontal elbow.
- E. Use hangers with 1-1/2" minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5-feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor hub.
- H. Where several pipes to be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide steel lead, 30 mil tape, or synthetic packing between hanger or support, and copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Rigidly secure anchorage devices against displacement by concrete placement operations.

- M. Examine substrates and conditions where supports and anchors are to be installed. Do not install until unsatisfactory conditions have been corrected.
- N. Hose faucets, compressed air outlets, and similar fixtures at ends of pipe branches shall be supported within 3 inches.
- O. All anchors shall be set accurately. Rigidly secure anchorage devices against displacement by concrete placement operations. Cast-in-place anchor bolts shall be set before the concrete has been placed and shall be carefully held in position with suitable templates or hardware. If adhesive or expansion anchors are installed after the concrete has been placed, all necessary drilling, grouting, caulking, non-destructive testing, repairs, testing, and cleaning shall be completed at no additional cost to the Owner. The Contractor shall locate existing concrete reinforcing with non-destructive methods prior to drilling or coring holes for anchors and shall adjust spacing of anchors to avoid reinforcing. Care shall be taken to avoid damage to the structures or finishes by cracking, chipping, spalling, or other damage during anchor placement.
- P. Construct supports of steel members or steel pipe and fittings, made of materials appropriate for the application. Brace and fasten with bolted flanges.

#### 3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, a minimum 4" thick and extending a minimum of 6" each side beyond supported equipment.
- B. Equipment manufacturer or Contractor's Arkansas certified professional engineer shall provide templates for anchoring equipment. Contractor shall provide anchor bolts and accessories for mounting and anchoring equipment.
- C. Construct equipment supports of steel members or steel pipe and fittings. Brace and fasten with bolted flanges.
- D. Bases and supports shall be accurately located and installed to template furnished.
- E. Support equipment as needed with approved anchorage to prevent swaying, sagging, vibration, and resonance; however, allow for thermal expansion between supports or anchors by providing flexible connections such as expansion joints, bellows, or rubber boots and sleeves. Contractor shall supply expansive materials or products, unless otherwise indicated.
- F. Minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall be not less than 4-1/2 times the diameter of the hole in which it is installed.
- G. Provide mounting frames and brackets for fans, pumps, and compressors to carry the load of the equipment without causing mechanical distortion or stress to the equipment.
- H. Restraints at base supported equipment shall include resilient neoprene pads at all potential contact areas between isolated equipment and rigid restraining element.

#### 3.5 PIPE SLEEVES

- A. All pipes passing through walls shall be fitted with sleeves. Each sleeve shall extend through its respective floor or wall, and shall be cut flush with each surface, except

floor sleeves which shall be extended to a minimum of 1 inch above floor.

- B. Unless otherwise specified, sleeves shall be two pipe sizes larger than the passing pipe, when the pipe is uncovered, and one pipe size larger than the overall outside diameter of the pipe insulation when insulated.
- C. Sleeves in floor slabs or walls below grade shall be standard galvanized steel pipe and caulked watertight. Sleeves in other walls shall be 20-gauge galvanized steel or non-ferrous metal or other approved materials; all sleeves shall be properly installed and securely fastened in place prior to pouring concrete.
- D. Sleeves or pipes shall not be installed in spread footing. Install pipe below footing; above footing with sleeve; or step footing to accommodate sleeve above.

### 3.6 ATTACHING TO STRUCTURES

- A. Where equipment or piping is supported from building steel beam, use clamps or welded beam attachments. Do not drill holes in building steel for hanger support rods.
- B. Anchor mechanical supports to wood structural beams and truss with lag screws, wood screws, nails or other appropriately sized fasteners complying with industry standard.

### 3.7 AUXILIARY STEEL

- A. Furnish all miscellaneous structural members necessary to hang or support pipe or mechanical equipment. Material members shall be consistent with that of the main structural system.
- B. Furnish all auxiliary steel with one shop coat of primer paint.
- C. Arrange for any adjustment necessary in main structural system for proper support of major equipment.

### 3.8 HANGER RODS AND SPACING

- A. Hanger rod sizes shall be sized by the load on the hanger as the determining factor and the maximum recommended hanger rod load as catalog listed shall govern.
- B. Pipe hanger spacing shall not exceed that required by the Arkansas Mechanical Code.

### 3.9 CONCRETE PADS

- A. Where shown on the Drawings, provide concrete pads under all floor-mounted equipment and apparatus. Reinforce pads with 6 x 6 x Wl.4 x Wl.4 W.W.F.
- B. Construct pads nominal 4" thick, unless indicated otherwise on Drawings.
- C. Concrete to be 3000 psi.

END OF SECTION

## SECTION 01 6610

### DELIVERY, STORAGE AND HANDLING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

##### 1.02 TRANSPORTATION AND DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.
- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the OWNER.
- C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
- D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting, and installing.
- E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
- F. Provide necessary equipment and personnel to unload all items delivered to the site.
- G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. OWNER, other Contractors), perform inspection in the presence of the OWNER. Notify OWNER verbally, and in writing, of any problems.
- H. If any item has been damaged, such damage shall be repaired at no additional cost to the OWNER.

##### 1.03 STORAGE AND PROTECTION

- A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the OWNER by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.
- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- C. Cement and lime shall be stored under a roof and off the ground and shall always be kept completely dry. All structural, miscellaneous, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping, or cracking. Brick, block, and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking, and spalling to a minimum.

- D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the OWNER. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer. The OWNER may offer existing spaces available to the Contractor for storage of these items but this is in no way guaranteed and the OWNER does not accept any liability for theft, damage, or loss occurring while the material is stored in their space. The Contractor must coordinate with the OWNER if space has been offered and the Contractor chooses to utilize said OWNER space.
1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
  2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
  3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance, unless the period between installation and acceptance is less than  $\frac{1}{2}$  the time period between factory recommended lubricant changes.
  4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.
- E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

#### 1.04 HANDLING PIPELINE MATERIALS

- A. The CONTRACTOR shall handle the material with utmost care and in a manner to prevent damage to the materials, material coating, and lining, during loading, hauling, unloading, and installation operations. Damaged material shall be replaced or repaired by the CONTRACTOR at his/her expense.
- B. Hooks shall not be in contact with the pipe exterior.
- C. The interior of the pipeline materials shall always be kept free from dirt and foreign matter .
- D. Pipeline materials, especially valves, hydrants, and fittings shall be drained and stored in a manner to protect them from damage by freezing.

END OF SECTION

SECTION 01 7710

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:
  - 1. Operation and Maintenance Data (Section 01\_8823).
  - 2. Project Record Documents (Section 01\_7839).
  - 4. Spare parts and maintenance materials (spare paint, lubricants, special tools).
  - 5. Record Shop Drawings (Section (01\_3000).
  - 6. Warranties and Bonds (Section (01\_7836).
  - 7. Reconciliation of final accounting, final change order, final payment application (General Conditions) and Contractor's releases.
  - 8. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.02 RELATED WORK

- A. Operation and Maintenance (O&M) data and manuals (Section 01\_8823) and applicable Sections in Technical Divisions.
- B. Project Record Documents (Section 01\_7839).

1.03 CLOSEOUT PROCEDURES

- A. Provide all deliverables as specified, prior to submitting the final payment application.
- B. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.
- C. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.
- D. Submit Contractor's Final Release and Release of Liens with final payment application.

1.04 FINAL CLEANING

- A. CONTRACTOR to complete final cleaning prior to submittal of the final application for payment.
- B. The CONTRACTOR shall remove all materials, equipment, tools, temporary structures, barricades, and trees and other vegetation that have been cut or have died as a result from the work, from both public and private property along the job site.
- C. There shall be no burning on the job site unless approved, in advance, by the OWNER.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION



## SECTION 01 7836

### WARRANTIES AND BONDS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

##### 1.02 RELATED WORK

- A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.
- B. General closeout requirements are included in Section 01\_7710 - Project Closeout.
- C. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

##### 1.03 SUBMITTALS

- A. Submit written warranties to the OWNER prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the OWNER.
- B. When a designated portion of the work is completed and occupied or used by the OWNER, by separate agreement with the CONTRACTOR during the construction period, submit properly executed warranties to the OWNER within 15 days of completion of that designated portion of the Work.
- C. When a special warranty is required to be executed by the CONTRACTOR, or the CONTRACTOR and a subcontractor, supplier, or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the OWNER for approval prior to final execution.
- D. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

##### 1.04 WARRANTY REQUIREMENT

- A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The CONTRACTOR is responsible for the cost of replacing or rebuilding defective work regardless of whether the OWNER has benefited from use of the work through a portion of its anticipated useful service life.

- D. OWNER's Recourse: Written warranties made to the OWNER are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the OWNER can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The OWNER reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.
- F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the CONTRACTOR of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the CONTRACTOR.

1.05 MANUFACTURERS CERTIFICATIONS

- A. Where required, the CONTRACTOR shall supply evidence, satisfactory to the Engineer, that the CONTRACTOR can obtain manufacturers' certifications as to the CONTRACTOR's installation of equipment.

1.06 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the OWNER.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

## SECTION 01 7839

### PROJECT RECORD DOCUMENTS

#### PART 1 GENERAL

##### 1.01 SCOPE

The CONTRACTOR shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

##### 1.02 RELATED REQUIREMENTS

- A. Contract close-out submittals are included in Section 01\_7710.
- B. Warranties and bonds are included in Section 01\_7836.
- C. Record shop drawings are included in Section 01\_3000.

##### 1.03 REQUIREMENTS INCLUDED

- A. CONTRACTOR shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:
  - 1. Contract Drawings
- B. CONTRACTOR shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.
  - 1. Field Orders, Change Orders, Design Modifications, and RFIs
  - 2. Field Test records
  - 2. Permits and permit close-outs (final approvals)
  - 3. Certificate of Occupancy or Certificate of Completion, as applicable
  - 4. Laboratory test reports (e.g., bacteriological and primary & secondary water quality)
  - 5. Certificates of Compliance for materials and equipment
  - 6. Samples

## C. RECORD DRAWINGS

1. The CONTRACTOR shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the WORK, as constructed.
2. These annotated Contract Drawings constitute The CONTRACTOR's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.
3. Record drawings shall be accessible to the OWNER and Engineer at all times during the construction period.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

- A. Store documents and samples in CONTRACTOR's field office apart from documents used for construction.
  1. Provide files and racks for storage of the record documents.
  2. Provide locked cabinet(s) or secure storage space for storage of samples.
- B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.
- C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and sample available for inspection by the Engineer or OWNER at all times.

### 3.02 MARKING METHOD

- A. Use the color *Red* (indelible ink) to record information on the Drawings.
- B. Label each document "PROJECT RECORD" in neat large printed letters.
- C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.
- D. Record information contemporaneously with construction progress.
- E. Legibly mark drawings with as-built information:
  1. Elevations and dimensions of structures and structural elements.

2. All underground utilities (piping and electrical), structures, and appurtenances
  - a. Changes to existing structure, piping and appurtenance locations.
  - b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
  - c. Record actual installed pipe material, class, size, joint type, etc

### 3.03 RECORD INFORMATION COMPILATION

- A. Do not conceal any work until the required information is acquired.
- B. Items to be recorded include, but are not limited to:
  1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.
  2. Field changes of dimensions and/or details
    - 1) Interior equipment and piping relocations.
    - 2) Architectural and structural changes, including relocation of doors, windows, etc.
    - 3) Architectural schedule changes.
- C. Changes made by Field Order, Change Order, design modification, and RFI.
- D. Details not indicated on the original Contract Drawings.

### 3.04 SUBMITTAL

- A. If requested by the Engineer or OWNER, CONTRACTOR shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.
- B. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of Record Drawings to the ENGINEER conforming to the construction records of the CONTRACTOR. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the WORK. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.
- C. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of Record Documents to the ENGINEER conforming to the construction records of the CONTRACTOR. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.
- D. The information submitted by the CONTRACTOR into the Record Drawings and Record Documents will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data.
- E. Delivery of Record Drawings and Record Documents to the ENGINEER will be a prerequisite to Final payment.

- F. The CONTRACTOR shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION

## SECTION 01 8823

### OPERATION AND MAINTENANCE DATA

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

##### 1.02 RELATED WORK

- A. Submittals are included in Section 01\_3000.
- B. Contract closeout is included in Section 01\_7710
- C. Warranties and Bonds are included in Section 01\_7836.

##### 1.03 OPERATING MANUALS

- A. Provide operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.
- B. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following:

###### 1. Format and Materials

###### a. Binders:

- 1) Commercial quality three ring binders with durable and cleanable plastic covers
- 2) Maximum ring width capacity: 3 inches
- 3) When multiple binders are used, correlate the data into related consistent groupings/volumes.

###### b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:

- 1) Title of Project.
- 2) Identify the general subject matter covered in the manual
- 3) Identify structure(s) and/or location(s), as applicable
- 4) Specification Section number

###### c. 20 lb loose leaf paper, with hole reinforcement

###### d. Page size: 8-1/2 inch by 11 inch

- e. Provide heavy-duty fly leafs (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
  - f. Provide reinforced punched binder tab; bind in with text.
  - g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.
2. Contents:
- a. A table of contents/Index
  - b. Specific description of each system and components
  - c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
  - d. Specific on-site operating instructions (including starting and stopping procedures)
  - e. Safety considerations
  - f. Project specific operational procedures
  - g. Project specific maintenance procedures
  - h. Manufacturer's operating and maintenance instructions – specific to the project
  - i. Copy of each wiring diagram
  - j. Copy of approved shop drawing(s) and CONTRACTOR's coordination/layout drawing(s)
  - k. List of spare parts and recommended quantities
  - l. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
  - m. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams
  - n. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
  - o. Warranties and Bonds, as specified in the General Conditions
3. Transmittals
- a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: the CONTRACTOR's name and address, OWNER's name, project name, project number, submittal number, description of submittal and number of copies submitted.
  - b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or otherwise directed by the Engineer.



- c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.
- C. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:
  1. Overview of system and 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 commercial number of replaceable parts.
  2. Panelboard circuit directories including electrical service characteristics, controls and communications and color coded wiring diagrams as installed.
  3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
  4. Maintenance Requirements
    - a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
    - b. Alignment, adjusting, balancing and checking instructions
    - c. Servicing and lubrication schedule and list of recommended lubricants
    - d. Manufacturer's printed operation and maintenance instructions
    - e. Sequence of operation by instrumentation and controls manufacturer
    - f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
  5. Control diagrams by controls manufacturer as installed (as-built)
  6. CONTRACTOR's coordination drawings, with color coded piping diagrams, as installed (as-built)
  7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.
  8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
  9. Test and balancing reports, as required
  10. Additional Requirements as specified in individual product specification
  11. Design data for systems engineered by the CONTRACTOR or its Suppliers
- D. Electronic Transmission of O&M Manuals
  1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM. Electronic O&M manuals shall meet the following conditions:
    - a. The above-specified transmittal form is included.

- b. All other requirements specified above have been met, including, but not limited to, coordination by the CONTRACTOR, review and approval by the Contactor.
  - c. The submittal contains no pages or sheets large than 11 x 17 inches.
  - d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
  - e. Files are Portable Document Format (PDF) – with the printing function enabled.
- 2. When electronic copies are provided, transmit two hard-copy (paper) originals to the Engineer with an electronic copy on CD-ROM.
  - 3. The electronic copy of the O&M manual must be identical in organization, format and content to the hard copies of the manual.

#### 1.04 SERVICES OF MANUFACTURERS' REPRESENTATIVE

- A. All electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment; and, to instruct the OWNER's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods to suit the CONTRACTOR's schedule and/or the OWNER's personnel availability.
- B. See the detailed specifications for additional requirements for furnishing the services of manufacturer's representatives.
- C. The manufacturer's representative shall certify that the installation of the equipment is satisfactory; that the unit has been satisfactorily tested; that the equipment is ready for operation; and, that the operating personnel have been suitably instructed in the operation, maintenance, care, and safe operation of the equipment. The *Equipment Manufacturer's Certificate of Installation, Testing, and Instruction* attached to this Section shall be used for this certification.
- D. For other materials furnished under other specification Sections, furnish the services of approved representative(s) of the manufacturer when, in the opinion of the Engineer, some evident product failure or malfunction makes such services necessary.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION

##### 3.01 SUBMITTAL SCHEDULE

- A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:
  - 1. Preliminary copies of manuals shall be submitted to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.
  - 2. Provide one (1) hard copy and six (6) electronic copies on separate labeled CD's of complete manuals prior to testing and start-up.

- B. The Engineer will review Operation and Maintenance manuals submittals on operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the *O&M Manual Review Checklist* appended to this Section.
- C. If during test and start-up of equipment, any changes were made to the equipment, provide copies (the number specified in paragraph 3.01.A.2) of as-built drawings or any other amendments for insertion in the final manuals. Submit the required number within 30 days of start-up and testing of the facility.

### 3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

- A. Before final initiation of operation, CONTRACTOR's vendors shall train/instruct OWNER's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the OWNER.
- B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of two hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of OWNER's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the CONTRACTOR's "normal working hours" or the OWNER's normal day shift.
- C. Use operation and maintenance manuals as basis for instruction. Train/instruct the OWNER's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.
- D. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.
- E. Vendor's training/instruction will be considered acceptable based on the completed *OWNER's Acknowledgement of Manufacturer's Instruction* as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

END OF SECTION

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION, TESTING AND INSTRUCTION

OWNER: \_\_\_\_\_

Project: \_\_\_\_\_

Contract No. \_\_\_\_\_

CDM Project No. \_\_\_\_\_

EQUIPMENT SPECIFICATION SECTION \_\_\_\_\_

EQUIPMENT DESCRIPTION \_\_\_\_\_

I \_\_\_\_\_, Authorized representative of (Print Name)

\_\_\_\_\_ (Print Manufacturer's Name)

hereby CERTIFY that \_\_\_\_\_ (Print equipment name and model with serial No.)

installed for the subject project [has] [have] been installed in a satisfactory manner, [has] [have] been satisfactorily tested, [is] [are] ready for operation, and that OWNER assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit[s] on Date: \_\_\_\_\_ Time: \_\_\_\_\_.

CERTIFIED BY: \_\_\_\_\_ DATE: \_\_\_\_\_ (Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

[I] [We] the undersigned, authorized representatives of the \_\_\_\_\_ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and [am] [are] prepared to assume normal operational responsibility for the equipment:

\_\_\_\_\_ DATE: \_\_\_\_\_

\_\_\_\_\_ DATE: \_\_\_\_\_

\_\_\_\_\_ DATE: \_\_\_\_\_

*O&M Manual Review Checklist*

Submittal No.: \_\_\_\_\_

Project No.: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Equipment Submitted: \_\_\_\_\_

Specification Section: \_\_\_\_\_

Date of Submittal: \_\_\_\_\_

**General Data**

- \_\_\_\_\_ 1. Are the area representative's name, address, e-mail address and telephone number included?
- \_\_\_\_\_ 2. Is the nameplate data for each component included?
- \_\_\_\_\_ 3. Are all associated components related to the specific equipment included?
- \_\_\_\_\_ 4. Is non-pertinent data crossed out or deleted?
- \_\_\_\_\_ 5. Are drawings neatly folded and/or inserted into packets?

**Operations and Maintenance Data**

- \_\_\_\_\_ 6. Is an overview description of the equipment and/or process included?
- \_\_\_\_\_ 7. Does the description include the practical theory of operation?
- \_\_\_\_\_ 8. Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?
- \_\_\_\_\_ 9. Are alarm and shutdown conditions clearly identified? Does it describe possible causes and recommended remedies?
- \_\_\_\_\_ 10. Are step procedures for starting, stopping, and troubleshooting the equipment included?
- \_\_\_\_\_ 11. Is a list of operational parameters to monitor and record for specific equipment included?
- \_\_\_\_\_ 12. Is a proposed operating log sheet included?
- \_\_\_\_\_ 13. Is a spare parts inventory list included for each component?
- \_\_\_\_\_ 14. Is a lubrication schedule for each component included - or does it clearly state "No Lubrication Required"?
- \_\_\_\_\_ 15. Is a maintenance schedule for each component included?
- \_\_\_\_\_ 16. Is a copy of the warranty information included?



**Review Comments**

Is the submittal fully approved (yes/no)?

If not, see the following are the points of rejection that must be addressed and require resubmittal by the CONTRACTOR:

Item No.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_
- 12. \_\_\_\_\_
- 13. \_\_\_\_\_
- 14. \_\_\_\_\_
- 15. \_\_\_\_\_

Reviewed By: \_\_\_\_\_ Date: \_\_\_\_\_

**Legend**

- 1 = OK
- 2 = Not Adequate
- 3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents





## SECTION 03 3100

### CONCRETE FORMWORK

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and design, install and remove formwork for cast-in-place concrete complete as shown on the Drawings and as specified herein.
- B. Secure to forms or set for embedment all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts, waterstops, and other items furnished under other Sections and required to be cast into concrete.

##### 1.02 RELATED WORK

- A. Concrete reinforcement is included in Section 03\_3200.
- B. Cast-in-place concrete is included in Section 03\_3300.
- C. Miscellaneous metals are furnished under Sections 05\_5000.
- D. Anchor bolts for equipment are furnished under Divisions 11, 13, 14, 15 and 16.

##### 1.03 SUBMITTALS

- A. Submit, in accordance with Section 01\_3000, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Form release agent
  - 2. Form ties
- B. Review will be for appearance, performance, and strength of the completed structure only. Approval by the Engineer will not relieve the CONTRACTOR of responsibility for the strength, safety or correctness of methods used, the adequacy of equipment, or from carrying out the work as shown on the Drawings and as specified herein.
- C. Sample Substrate
  - 1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not impair the bond of paint, sealant, waterproofing, dampproofing, or other coatings and will not affect the forming materials.
- D. Certificates
  - 1. Submit completed PE Certification Form for design of formwork in accordance with Section 01\_3000. The PE Certification Form shall be completed and stamped by a professional engineer registered in the State of Arkansas.
  - 2. Certify that form release agent complies with Federal, State and local VOC limitations.

##### 1.04 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
  - 1. ACI 301 - Specifications for Structural Concrete

2. ACI 318 - Building Code Requirements for Structural Concrete
  3. ACI 347 - Guide to Formwork for Concrete
  4. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
- B. APA - The Engineered Wood Association (APA)
1. Material grades and designations as specified
- C. 2006 International Building Code (IBC).
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.05 SYSTEM DESCRIPTION

- A. Structural concrete is defined as concrete that is not architectural concrete.
- B. Structural design responsibility: CONTRACTOR shall provide all forms and shoring designed by a professional engineer registered in the State of Arkansas. Design and erect formwork in accordance with the requirements of ACI 301, ACI 318/350 and ACI 347. Comply with all applicable regulations and codes. Consider any special requirements due to the use of plasticized and/or retarded set concrete.

### PART 2 PRODUCTS

#### 2.01 GENERAL

- A. The usage of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

#### 2.02 MATERIALS

A. Forms, General

1. Make forms for cast-in-place concrete of wood, steel or other approved materials, except as specified in Paragraphs 2.02B and 2.02C.2. Construct wood forms of sound lumber or plywood free from knotholes and loose knots. Construct steel forms to produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing except as specified.

B. Forms for Exposed Structural Concrete

1. Make forms for all exposed and non-submerged exterior and interior concrete of new and unused Plyform exterior grade plywood panels manufactured in compliance with the APA and bearing the APA trademark. Provide B grade or better veneer on all faces to be in contact with concrete. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing except as specified.
2. Provide rigid forms that will not deflect, move, or leak. Design forms to withstand the high hydraulic pressures resulting from rapid filling of the forms and heavy high frequency vibration of the concrete. Limit deflection to 1/400 of each component span. Lay out form joints in a uniform pattern.
3. Dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Tape, gasket, plug, and/or caulk all joints and gaps in forms to provide watertight joints that

will withstand placing pressures without exceeding specified deflection limit or creating surface patterns.

4. Provide 3/4-inch chamfer on all corners unless otherwise indicated.

C. Column Forms

1. Form rectangular columns as specified for exposed structural concrete. Provide 3/4-in chamfer on all corners unless otherwise indicated.

D. Provide rustications as indicated. Mill and plane smooth moldings for chamfers and rustications. Provide rustications and chamfer strips of nonabsorbent material, compatible with the form surface and fully sealed on all sides to prevent the loss of paste or water between the two surfaces.

E. Form Release Agent. Coat all form surfaces in contact with concrete with an effective, non-staining, non-residual, water based or vegetable oil based, bond-breaking form coating unless otherwise indicated or specified. Form release agent shall not impair the bond of special coating systems where applicable.

1. Water based form release agent shall be DUOGARD II by W.R. Meadows, GCC-100FR by SEI Chemicals, or approved equal.
2. Vegetable oil based form release agent shall be FARM FRESH by CMC Construction Services, Bio Release EF by DS Construction Chemicals, or approved equal.

F. Form Ties

1. Coil and Wire Ties: Provide ties manufactured so that, after removal of the projecting part, no metal remains within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a plastic or wooden cone at least 1/2-in diameter and 1-1/2-in long. Provide cone washer type form ties in concrete exposed to view.
2. Flat Bar Ties for Panel Forms: Provide ties that have plastic or rubber inserts with a minimum depth of 1-1/2-in and manufactured to permit patching of the tie hole.
3. Provide ties for liquid retaining structures and exterior below grade walls that have a steel waterstop tightly attached to each strut or that have a neoprene rubber washer on each strut.
4. Do not use common wire for form ties.
5. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used. Install in forms so that large end is, where applicable, on the liquid or backfilled side of the wall. Clean, fill and seal form tie hole with non-shrink cement grout to provide watertight form tie holes and make all repairs needed to make watertight.
6. Alternate form ties specified in Paragraph 2.02F.5 may be used when forms are to be set against previously placed or existing concrete walls. Use in conjunction with cast-in threaded inserts or drilled-in threaded anchors so that no metal remains within expansion joint upon removal of tapered through bolt. Conform to requirements specified in Paragraph 2.02I.5.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Provide forms for all cast-in-place concrete including sides of footings. Construct and place forms to provide concrete of the shape, lines, dimensions, and appearance indicated.
- B. Provide removable panels at the bottom of forms for walls and columns to allow cleaning, inspection, and joint surface preparation. Provide closable intermediate inspection ports in forms for walls. Provide tremies and hoppers for placing concrete and to allow concrete sampling, prevent segregation and prevent the accumulation of hardened concrete on the forms and reinforcement above the fresh concrete.
- C. Place molding, bevels, or other types of chamfer strips to produce blockouts, rustications, or chamfers as indicated on the Drawings or as specified herein. Provide chamfer strips at horizontal and vertical projecting corners to produce a 3/4-in chamfer. Provide rectangular moldings at locations requiring sealants where shown on the Drawings or specified herein.
- D. Provide rigid forms to withstand construction loads and vibration and meeting specified deflection limits and tolerances. Construct forms so that the concrete will not be damaged by form removal.
- E. Accessories which remain embedded in the concrete after formwork removal will be subject to the approval of the Engineer. Permanent embedments shall have sufficient concrete cover or be of suitable materials for the exposure condition as approved by the Engineer. Remove unsatisfactory embedded items at no additional cost to the OWNER.

### 3.02 FORM TOLERANCES

- A. Design, construct and surface forms in accordance with ACI 347 and meet the following additional requirements for the specified finishes.
- B. Forms for Exposed Structural Concrete: Edges of all form panels in contact with concrete flush within 1/8-in and forms for plane surfaces plane within 1/8-in in 4-ft. Maximum deviation of the finished surface at any point not to exceed 1/4-in from the intended surface indicated. Arrange form panels symmetrically and orderly to minimize the number of seams. Provide tight forms to prevent the passage of mortar, water, and grout.
- C. Formed Surface Not Exposed to View or Buried: Class "C" Surface per ACI 347.
- D. Formed Surface Including Mass Concrete, Pipe Encasement, Electrical Raceway Encasement and Other Similar Installations: No minimum requirements for surface irregularities and surface alignment. The overall dimensions of the concrete shall be plus or minus 1-in from the intended surface indicated.

### 3.03 FORM PREPARATION

- A. Clean, repair, remove projecting nails and fill holes, and smooth protrusions on all form surfaces to be in contact with concrete before reuse. Do not reuse forms for exposed concrete unless a "like new" condition of the form is maintained that will produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.
- B. Coat wood forms in contact with concrete using form release agent prior to form installation.
- C. Clean steel forms by sandblasting or other method to remove mill scale and other ferrous deposits from the contact surface of all forms. Coat steel forms in contact with concrete using form release agent prior to form installation.

### 3.04 REMOVAL OF FORMS

- A. The CONTRACTOR shall be responsible for all damage resulting from removal of forms and make repairs at no additional cost to the OWNER. Leave in place forms and shoring for horizontal structural members in accordance with ACI 301 and ACI 347. Conform to the requirements for form removal specified in Section 03\_3000.

### 3.05 INSPECTION

- A. The OWNER or the registered design professional in responsible charge acting as the OWNER's agent shall employ one or more special inspectors to provide inspections during construction.
- B. Special inspection shall be performed in accordance with Section 1704.4 and table 1704.4 of the IBC.
- C. The Engineer shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.
- D. Failure of the forms to comply with the requirements specified, or to produce concrete complying with requirements specified shall be grounds for rejection of that portion of the concrete work. Repair or replace rejected work as directed by the Engineer at no additional cost to the OWNER. Such repair or replacement shall be subject to the requirements of these Specifications and approval of the Engineer.

END OF SECTION



## SECTION 03 3200

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein, including dowels embedded into concrete or masonry.

##### 1.02 RELATED WORK

- A. Concrete formwork is included in Section 03\_3100.
- B. Cast-in-place concrete is included in Section 03\_3300.
- C. Modifications to existing concrete are included in Section 03\_3750.

##### 1.03 SUBMITTALS

- A. Submit, in accordance with Section 01\_3000, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Reinforcing steel. Drawings for fabrication, bending, and placement of concrete reinforcement shall conform to the recommendations of ACI 315 for placement drawings and as specified herein.
    - a. Placement drawings. For walls, show elevations from the outside, looking towards the structure, at a minimum scale of 1/4-in to one foot. For slabs, show top and bottom reinforcement on separate plan views, as needed for clarity. For beams and columns, show schedules with sections and/or elevations and stirrup/tie spacing. Show additional reinforcement around openings, at corners and at other locations indicated, diagrams of bent bars, arrangements, and assemblies, all as required for the fabrication and placement of concrete reinforcement. Reference bars to the same identification marks shown on the bar bending details. Identify bars to have special coatings and/or to be of special steel or special yield strength. Regardless, all reinforcing steel yield strength shall be indicated on the drawings.
    - b. Bar bending details. Reference bars to the same identification marks shown on the placement drawings. Identify bars to have special coatings and/or to be of special steel or special yield strength.
  - 2. Fiber reinforcement. Submit manufacturer's data for synthetic reinforcing fibers. Identify all placements that are to contain synthetic reinforcing fibers. The fiber length and amount of fibers per cubic yard to be used for each placement shall be noted. Submit two samples of synthetic reinforcing fibers.
- B. Submit samples of each of the following items.
  - 1. Two samples of each type of mechanical reinforcing steel coupling system, if used.
- C. Submit, in accordance with Section 01\_3000, Test Reports of each of the following items.

1. Certified copy of mill tests on each heat of each steel proposed for use showing the physical properties of the steel and the chemical analysis for all indicated reinforcement sizes.
2. Welder's certification in accordance with AWS D1.4 when welding of reinforcement is indicated, specified, or approved.

#### 1.04 REFERENCE STANDARDS

##### A. American Society for Testing and Materials (ASTM)

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
6. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
7. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
8. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
9. ASTM D7357 - Standard Specification for Cellulose Fibers for Fiber Reinforced Concrete

##### B. American Concrete Institute (ACI)

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 350 – Building Code Requirements for Environmental Engineering Concrete Structures
5. SP-66 (ACI 315) ACI Detailing Manual.

##### C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

##### D. American Welding Society (AWS)

1. AWS D1.4 Structural Welding Code - Reinforcing Steel

##### E. ICC Evaluation Service



1. ICC-ES AC217 – Acceptance Criteria for Concrete with Virgin Cellulose Fibers

F. 2006 International Building Code (IBC).

G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Fiber Reinforcement. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the synthetic reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

1.06 DELIVERY, HANDLING AND STORAGE

A. Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter.

B. Ship and store reinforcement with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placement drawings. Tags for ASTM A706 reinforcing and for ASTM A615 reinforcing meeting the requirements of Paragraph 2.01.C.1 shall indicate that the reinforcing is weldable.

C. Store reinforcement off the ground, protect from moisture and keep free from rust, mud, dirt, grease, oil, ice, or other injurious contaminants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide new materials of domestic manufacture complying with the following material specifications.

B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

C. Deformed Concrete Reinforcing Bars required on the Drawings to be Field Bent or Welded: ASTM A706.

1. ASTM A615, Grade 60 may be substituted for ASTM A706 subject to the following:

a. The actual yield strength of the reinforcing steel based on mill tests does not exceed the specified yield strength by more than 18,000 psi. Retests not to exceed this value by more than an additional 3,000 psi.

b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement is not less than 1.25.

c. The carbon equivalency (CE) is 0.55 percent or less.

D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.

E. Welded Deformed Steel Wire Fabric: ASTM A497.

F. Reinforcing Steel Accessories

1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.
2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.
3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

G. Tie Wire

1. Tie Wires for Reinforcement: 16-gauge or heavier black annealed wire.

H. Mechanical Reinforcing Steel Coupling System

1. Use only where indicated. Mechanical reinforcing steel coupling system shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton Lock rebar splices as manufactured by Erico Products Inc., Solon, OH or approved equal. Coupling system shall meet all ACI 318/350 requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Provide with cap on female end to exclude dirt, debris and wet concrete. Couplers shall be torqued to manufacturer's recommended value.
2. Unless otherwise noted on the Drawings, mechanical reinforcing steel coupling system shall produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the reinforcing bar. Base yield strength on Grade 60 reinforcing unless otherwise indicated or specified.
3. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar.

I. Fiber Reinforcement

1. Synthetic reinforcing fibers for concrete grout shall be 100 percent polypropylene collated, fibrillated fibers, Fibermesh 300 as manufactured by Propex Concrete Systems Corp, Chattanooga, TN, or equal. Fiber length and quantity for the concrete grout mix shall be in strict compliance with the manufacturer's recommendations and as approved by the Engineer.
2. Alternatively, virgin cellulose fiber reinforcing may be substituted for use in concrete grout applications. The fiber material shall be Ultrafiber 500 by Buckeye Technologies or an approved equal conforming to ASTM D7357. Fiber application rate shall be in strict compliance with the manufacturer's recommendations and as approved by the Engineer.

J. Form Savers

1. Form savers are to be used only where shown in the Drawings or where approved, in writing, by the Engineer. Form savers shall be a Lenton Form Saver by Erico Products Inc., Solon, OH or approved equal.

## 2.02 FABRICATION

- A. Comply with the CRSI Manual of Standard Practice.
- B. Bend bars cold. Do not straighten or rebend bars.
- C. Bend bars around a revolving collar having a diameter not less than that recommended by the CRSI or ACI 318/350.

- D. Saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Terminate saw cut ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Comply with the CRSI Manual of Standard Practice for surface condition, bending, spacing and tolerances of placement for reinforcement. Provide the amount of reinforcing indicated at the spacing and clearances indicated on the Drawings.
- B. Determine clear concrete cover based on exposure to the environment. Unless indicated otherwise on the Drawings, provide the following minimum clear concrete cover over reinforcement:
  - 1. Concrete cast against and permanently exposed to earth: 3-in
  - 2. Concrete exposed to soil, water, chemicals, and/or weather:
    - a. Slabs (top and bottom cover), walls: 2-in
    - b. Beams and columns (ties, spirals and stirrups): 2-in
  - 3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
    - a. Slabs (top and bottom cover [#11 bars and smaller]), walls: 1-in
    - b. Beams and columns (ties, spirals and stirrups): 1-1/2-in

For conditions or elements not described above, refer to Chapter 7 in ACI 318/350.

- C. Coat uncoated reinforcement which will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.
- D. Do not weld reinforcing steel bars either during fabrication or erection unless indicated on the Drawings or as specified herein, or unless prior written approval has been obtained from the Engineer. Remove immediately all bars that have been welded, including tack welds, without such approval. Comply with AWS D1.4 when welding of reinforcement is shown on the Drawings, specified, or approved.
- E. Reinforcing steel interfering with the location of other reinforcing steel, piping, conduits or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Obtain the approval of the Engineer if greater displacement of bars to avoid interference is needed. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- F. Secure, support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.
- G. Do not field bend reinforcing unless indicated or specifically authorized in writing by the Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace, repair by cutting out damaged bars and splicing new bars using coupling sleeves filled with ferrous material, or otherwise repair damaged reinforcing bars as directed by the Engineer

at no additional cost to the OWNER. Do not bend reinforcement after it is embedded in concrete.

### 3.02 REINFORCEMENT AROUND OPENINGS

- A. Provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by the opening unless indicated otherwise on the Drawings. Extend each end of each bar beyond the edge of the opening or penetration by the tension development length for that bar size.

### 3.03 SPLICING OF REINFORCEMENT

- A. Provide splices as shown on the Drawings and as specified herein.
- B. Splices Indicated as Compression Splices: Provide lap splice of 30 bar diameters, but not less than 12-in unless indicated otherwise on the Drawings. Base the lap splice length for column vertical bars on the bar size in the column above.
- C. All Other Splices: Provide tension lap splices in compliance with ACI 318/350. Stagger splices in adjacent bars where possible. Provide Class B tension lap splices at all locations unless otherwise indicated.
- D. Tension Members: Avoid splicing of reinforcing steel in concrete elements indicated as "tension members." However, if splices are required for constructability, splices in the reinforcement subject to direct tension shall be butted and joined with complete penetration welds or mechanical splices as indicated in 2.01.H to develop, in tension, at least 125 percent of the specified yield strength of the bar. Offset splices in adjacent bars the distance of a Class B splice or 30-in, whichever is greater.
- E. Lap splices in welded wire fabric in accordance with the requirements of ACI 318/350 but not less than 12-in. Tie the spliced fabrics together with wire ties spaced not more than 24-in on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.
- F. Mechanical reinforcing steel coupling system shall be used only where shown on the Drawings. Offset splices in adjacent bars by at least 30 bar diameters. Mechanical reinforcing steel coupling system is only to be used for special splice and dowel conditions approved by the Engineer.

### 3.04 ACCESSORIES

- A. Determine, provide and install accessories such as chairs, chair bars and the like to support the reinforcement providing the spacing and clearances indicated on the Drawings and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Use plastic protected bar supports or steel supports with plastic tips where the reinforcing steel is to be supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use stainless steel protected bar supports in walls, beams and elevated slabs. Use stainless steel supports or plastic tipped metal supports in all other locations unless otherwise noted on the Drawings or specified herein.
- D. Provide #5 minimum size support bars. Do not reposition upper bars in a bar mat for use as support bars.

- E. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

### 3.05 INSPECTION

- A. The OWNER or the registered design professional in responsible charge acting as the OWNER's agent shall employ one or more special inspectors to provide inspections during construction.
- B. Special inspection shall be performed in accordance with Section 1704.4 and table 1704.4 of the IBC.
- C. The Engineer shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.
- D. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, quantity, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

END OF SECTION



## SECTION 03 3300

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.
- B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of the CONTRACTOR. Any field sampling, testing, inspection and related tests will be provided by the CONTRACTOR.

##### 1.02 RELATED WORK

- A. Concrete formwork is included in Section 03\_3100.
- B. Concrete reinforcement is included in Section 03\_3200.
- C. Miscellaneous metals are included in Section 05\_5000.

##### 1.03 SUBMITTALS

- A. Submit, in accordance with Section 01\_3000, product data and information for:
  - 1. Sources of cement, fly ash, aggregates, and batched concrete.
  - 2. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
  - 3. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
  - 4. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.
  - 5. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
  - 6. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.
  - 7. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.

8. Procedures for mass concrete placement as defined in Section 3.06.9.
9. Cold and hot weather concrete placement procedures in accordance with Section 3.07.D and 3.07.E, respectively.

B. Samples

1. Fine and coarse aggregates if requested for examination by the Engineer.

C. Test Reports

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, deleterious substance content, and mortar bar expansion test results.
2. Cement and fly ash: Conformance to ASTM standards, including chemical analysis and physical tests.
3. Concrete mixes: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash. Provide either Paragraph a. or b., below, for each mix proposed.

- a. Standard deviation data for each proposed concrete mix based on statistical records.

Provide the following for each strength data point used in the calculation of the standard deviation for determination of the minimum required average strength:

- i. Date of sampling and name of testing laboratory.
- ii. Name of concrete batch plant.
- iii. Water cementitious ratio.
- iv. Slump of batch.
- v. Air content of batch.
- vi. Compressive strengths of all cylinders tested at that age in that batch.
- vii. If available, temperature and unit weight of batch.

Provide data from projects not more strictly controlled than outlined in these specifications. Provide summary sheet showing all pertinent data and the computation of the standard deviation. Test results shall be within the previous 12-months.

- b. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at 7 and 28 days for laboratory concrete mix designs. Provide results of 14 day tests if available. Test results shall be within the previous 12-months.
4. Mix Water: Submit test reports verifying conformance with ASTM C1602 for all non-potable water used as mixing water in concrete mix designs specified herein. This requirement can be neglected if potable water sources are used as mixing water.



#### D. Certifications

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify that the CONTRACTOR is not associated with the independent testing laboratory proposed for use by the CONTRACTOR nor does the CONTRACTOR or officers of the CONTRACTOR's organization have a beneficial interest in the laboratory.
3. Certificate of conformance for concrete production facilities from the NRMCA.

#### E. Qualifications

1. Independent Testing Laboratory
  - a. Name and address
  - b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
  - c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
  - d. Names and qualifications of the supervising laboratory technicians.
  - e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by the Engineer.
  - f. Submit as required above for other organizations that will provide external technical services.

### 1.04 REFERENCE STANDARDS

#### A. American Society for Testing and Materials (ASTM)

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

7. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
  8. ASTM C150 - Standard Specification for Portland Cement.
  9. ASTM C156 - Standard Test Method for Water Retention by Liquid Membrane-Forming Curing Compound for Concrete.
  10. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
  11. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  12. ASTM C192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
  13. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
  14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
  15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  16. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for use in Portland Cement Concrete.
  17. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
  18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
  19. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
  20. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
  21. ASTM C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
  22. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
- B. American Concrete Institute (ACI).
1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
  2. ACI 232.2R - Use of Fly Ash in Concrete.
  3. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.

4. ACI 304.2R - Placing Concrete by Pumping Methods.
  5. ACI 305R - Hot Weather Concreting.
  6. ACI 306R - Cold Weather Concreting.
  7. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
  8. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
- C. National Ready Mixed Concrete Association (NRMCA)
1. Quality Control Manual, Section 3 - Certification of Ready Mixed Concrete Production Facilities.
- D. 2006 International Building Code (IBC).
- E. Truck Mixer Manufacturers Bureau (TMMB)
1. TMMB 100 - Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.05 QUALITY ASSURANCE

- A. Comply with ACI 318/ACI 350, as applicable, and other stated specifications, codes and standards. Apply the most stringent requirements of other stated specifications, codes, standards, and this Section when conflicts exist.
- B. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the CONTRACTOR or in which the CONTRACTOR or officers of the CONTRACTOR's organization have a beneficial interest are not acceptable.
- C. Use only one source of cement and aggregates for the project. Provide concrete uniform in color and appearance.
- D. If, during the progress of the work, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the specified properties. Make all changes so ordered at no additional cost to the UTILITY.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, make, at no additional cost to the UTILITY, new acceptance tests of materials and establish new concrete mixes with the assistance of an independent testing laboratory.

- F. All field testing and inspection services and related laboratory tests required will be provided by the CONTRACTOR. The cost of such work will be paid for by the CONTRACTOR. Methods of testing will comply with the latest applicable ASTM methods. The following items will be tested by the CONTRACTOR to verify conformity with this Section.
- G. Provide field testing and inspection services and related laboratory tests. Methods of testing shall comply with the latest applicable ASTM methods. The following items shall be tested to verify conformity with this Section.
  - 1. Concrete placements - compressive strength (cylinders), compressive strength (cores), slump, and air content.
  - 2. Other materials that may require field testing.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Cement: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination and to prevent warehouse set.
- B. Aggregate: Arrange and use stockpiles to prevent segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
- C. Sand: Arrange and use stockpiles to prevent contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen sand.
- D. Admixtures: Store in closed containers to prevent contamination, evaporation or damage. Provide agitating equipment to uniformly disperse ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.
- E. Fly Ash: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.
- G. Liquid Curing Compounds: Store in closed containers.

### PART 2 PRODUCTS

#### 2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

## 2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic portland cement conforming to ASTM C150. Cement shall be low alkali cement. Do not use air entraining cements. Cement brand must be approved by the Engineer and one brand shall be used throughout the work. Provide the following type(s) of cement:
  - 1. Class A, and B Concrete - Type I/II; or Type II
  - 2. Class A, and B Concrete - Type I, I/II or Type II with the addition of fly ash resulting in  $C_3A$  being below 8 percent of total cementitious content.
  - 3. Type III cement, limited to 8 percent  $C_3A$ , may be used for Class A and/or Class B concrete, subject to approval by the Engineer, where high-early strength concrete is deemed necessary.
- C. Aggregates:
  - 1. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.
  - 2. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33. Grading requirements as listed in ASTM C33, Table 2 for the specified coarse aggregate size number listed in Table 1 herein. Limits of deleterious substances and physical property requirements as listed in ASTM C33, Table 3 for severe weathering regions. Do not use coarse aggregates known to be deleteriously reactive with alkalis in cement.
  - 3. The fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using the cement proposed for the project. If aggregates proposed for use do not meet this requirement, then satisfy either a. or b. below.
    - a. Total equivalent alkali content of the cement used shall not exceed 0.60 percent as provided in the Optional Chemical Requirements of ASTM C150.
    - b. The fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using the cement and fly ash proposed for the project. The proportions of the cement-fly ash mix shall be the same as those proposed for the project.
- D. Water: Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances. Non-potable water may be used where compliance with the requirements ASTM C1602 are shown to be satisfied. See also Item 1.03.C.4 above.
- E. Admixtures: Use admixtures free of chlorides and alkalis (except for those attributable to drinking water). The admixtures shall be from the same manufacturer when it is required to use more than one admixture in the same concrete mix. Use admixtures

compatible with the concrete mix including other admixtures and made for use in concrete in contact with potable water after 30 days of concrete curing.

1. Air Entraining Admixture: Conforming to ASTM C260. Proportion and mix in accordance with manufacturer's recommendations.
  2. Water Reducing Admixture: Conforming to ASTM C494, Type A. Proportion and mix in accordance with manufacturer's recommendations.
  3. High-Range Water-Reducing Admixtures (Plasticizer): Conforming to ASTM C494, Type F resulting in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cementitious ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportion and mix in accordance with manufacturer's recommendations.
  4. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from the Engineer. Use retarding or accelerating water reducing admixtures when so approved.
- F. Fly Ash: Class C or F fly ash complying with ASTM C618, including the requirements of Table 1 but with the Loss of Ignition (LOI) limited to 5 percent maximum. Test in compliance with ASTM C311 with a minimum of one sample weighing four pounds taken from each 200 tons of fly ash supplied for the project.
- G. Sheet Curing Materials: Waterproof paper, polyethylene film or white burlap-polyethylene sheeting, all conforming to ASTM C171.
- H. Liquid Curing Compound. Liquid membrane-forming curing compound conforming to ASTM C309, Type 1-D (clear or translucent with fugitive dye) and containing no wax, paraffin, or oil. Curing compound shall comply with Federal, State and local VOC limits. Liquid curing compounds shall not impair the bond of any specified coatings or sealants to be applied to the concrete following curing.
1. Curing compounds to be used for liquid containing structures shall be NSF 61 approved, be non-yellowing, and have a unit moisture loss no greater than 0.055 gm/cm<sup>2</sup> at 72 hours, as measured by ASTM C156.
    - a. Liquid curing compound shall be E-Cure by SpecChem LLC, or approved equal.
  2. Liquid curing compounds for non liquid containing structures shall have a minimum of 18 percent solids, be non-yellowing, and have a unit moisture loss no greater than 0.055 gm/cm<sup>2</sup> at 72 hours, as measured by ASTM C156.
    - a. Liquid curing compound shall be Super Aqua-Cure Vox by Euclid Chemical Company, or approved equal.

## 2.03 MIXES

- A. An independent testing laboratory engaged by and at the expense of the CONTRACTOR shall establish concrete mixes and perform all sampling and laboratory testing of products and materials.

- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce workable, durable concrete conforming to these specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.
- C. Base concrete mixes on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.
  - 1. For concrete mixes based on standard deviation data of prior mixes, submit standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318/350 and based on the modification factors for standard deviation tests contained in ACI 318/350.
  - 2. For concrete mixes developed by laboratory testing, base cementitious content of the concrete on curves showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. Determine curves by four or more points, each representing an average value of at least three test specimens and one water-cementitious ratio at each age. Provide curves with a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. The cementitious content of the concrete mixes to be used, as determined from the curve, shall correspond to the required average compressive strength in Table 5.3.2.2 of ACI 318/350 as applicable. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 1.
- D. Test the fly ash and concrete mixture to provide test data confirming that the fly ash in combination with the cement to be used meets all strength requirements and is compatible with the other concrete additives.
- E. Compression Tests: Provide testing of the proposed concrete mixes to demonstrate compliance with the compression strength requirements in conformity with the provisions of ACI 318/350.
- F. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
  - 1. If the air entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal specified under Paragraph 1.03.
- G. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducing admixture (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10-in.
- H. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).

TABLE 1  
CONCRETE MIX REQUIREMENTS

Class	Design Strength <sup>(1)</sup>	Cement <sup>(2)</sup>	Coarse Aggregate	Cementitious Content <sup>(4)</sup>		
A	4500	C150	67	535 min.		
B	3000	C150	67	560 min.		

Class	W/C Ratio <sup>(5)</sup>	Fly Ash <sup>(6)</sup>	AE Range <sup>(7)</sup>	WR <sup>(8)</sup>	HRWR <sup>(9)</sup>	Slump Range (in)
A	0.45 max.	Allowed 20% max.	3 to 6	Allowed	No	2-4 (6-8 after WR)
B	0.54 max.	Allowed 20% max.	3.5 to 5	No	No	4-6

Notes:

- (1) Minimum compressive strength in psi at 28 days.
- (2) ASTM Designation; Type as specified in Section 2.02.B
- (3) Size Number in ASTM C33
- (4) Cementitious content in lb/yd<sup>3</sup>, (where fly ash is used cementitious content is defined as cement content plus fly ash content)
- (5) W/C is Water-Cementitious ratio by weight
- (6) Fly ash meeting ASTM C618
- (7) AE is percent air-entrainment
- (8) WR is water-reducer admixture
- (9) HRWR is high-range water-reducer admixture; adjust W/C ratio accordingly

### PART 3 EXECUTION

#### 3.01 MEASURING MATERIALS

- A. Provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, water and admixtures as specified and produced by a plant complying with ACI 318/350 and ASTM C94. Batch all constituents, including admixtures, at the plant. High-range water reducing admixtures may be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Use scales last certified by the local Sealer of Weights and Measures within one year of use.
- C. Weigh cement and fly ash in individual weigh batchers that are separate and distinct from the weigh batchers used for other materials. When cement and fly ash are weighed in a cumulative weigh batcher, the cement shall be weighed first.
- D. Measure the amount of free water in fine aggregates within 0.5 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batch tickets.
- E. Dispense admixtures either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.



1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
2. Inject multiple admixtures separately during the batching sequence.

### 3.02 MIXING AND TRANSPORTING

- A. Provide ready-mixed concrete produced by equipment complying with ACI 318/350 and ASTM C94 and produced by a plant certified by the NRMCA. Do not hand-mix. All truck mixers shall carry a rating plate conforming to TMMB 100. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Transport ready-mix concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Incorporate water directed to be added by additional mixing of at least 50 revolutions at mixing speed after the addition of all water. Meter all added water and show the amount of water added on each delivery ticket.
- D. Comply with ACI 318/350 and ASTM C94 for all central plant and rolling stock equipment and methods.
- E. Select equipment of size and design to provide continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Do not re-temper (mix with or without additional cement, aggregate, or water) concrete or mortar which has partially hardened.
- G. Handle concrete from mixer to placement providing concrete of specified quality in the placement area and not exceeding the maximum time interval specified in Paragraph 3.02 I.4. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required to avoid excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Remix for a minimum of 5 minutes prior to discharge or testing.
- H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Indicate for each batch the weight of fine and coarse aggregate, cement, fly ash, and water, moisture content of fine and coarse aggregate at time of batching, and types, brand and quantity of each admixture, the quantity of concrete delivered, the time any water is added and the amount, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.

I. Temperature and Mixing Time Control

1. In cold weather (see Paragraph 3.07D) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 3.
2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
3. In hot weather (see Paragraph 3.07E), cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. Well-crushed ice may be substituted for all or part of the mixing water.
4. The maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed the following:

TABLE 2

<u>CONCRETE TEMPERATURE</u>	<u>MAXIMUM TIME</u>
(27 Degree C) 80 Degree F to 90 Degree F (32 Degree C)	45 minutes
(21 Degree C) 70 Degree F to 79 Degree F (26 Degree C)	60 minutes
(5 Degree C) 40 Degree F to 69 Degree F (20 Degree C)	90 minutes

If an approved high-range water-reducing admixture (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.03 INSPECTION AND COORDINATION

- A. Batching, mixing, transporting, placing, and curing of concrete shall be subject to the inspection of the Engineer at all times. Advise the Engineer of readiness to proceed at least six working hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment, cleanliness, and tightness of formwork. Do not place concrete without the inspection and acceptance of the Engineer.
- B. See also the requirements in Section 3.11 below.

3.04 EMBEDDED ITEMS

- A. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, anchors, inserts and other items furnished under other Sections and required to be embedded into concrete. Set and secure such items in the locations and alignments needed so they are not displaced by concrete placement.

- B. Clean embedded items free of rust, mud, dirt, grease, oil, ice, or other injurious contaminants.
- C. Coat or isolate all aluminum embedments to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- D. Do not embed piping in concrete unless shown on the Drawings.
- E. Do not embed electrical conduits in concrete unless shown on the Drawings.
- F. Pipes and conduits embedded within a slab or wall (other than those merely passing through) shall satisfy the following, unless otherwise shown on the Drawings or approved:
  - a. Maximum outside dimension of pipe or conduit shall not be greater than one third the overall thickness of the slab or wall.
  - b. Spacing of pipes or conduits shall be greater than or equal to three diameters or widths on center.
  - c. Fabricate piping and conduit such that the cutting, bending, or relocation of reinforcing steel is not required.
- G. Close open ends of piping, conduits, and sleeves embedded in concrete with caps or plugs prior to placing concrete.
- H. Ensure specified tests on embedded piping are completed and satisfactory before starting concrete placement. Ensure all mechanical or electrical tests and inspections are completed and satisfactory prior to starting concrete placement.
- I. Check location, alignment, and support of piping, electrical conduits, and other items fully or partially embedded before depositing concrete. Correct mis located and misaligned items and secure items which have become loose.
- J. Position embedded anchor bolts using templates.
- K. Correct all embedded items not installed in the location or alignment needed or displaced by concrete placement at no additional cost to the UTILITY.

### 3.05 CONCRETE APPEARANCE

- A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Reject remixed concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Make, at no additional cost to the UTILITY, changes in the concrete mix design for future deliveries only by adjusting one or more of the following if the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishing quality are observed:
  - 1. The gradation of aggregate.
  - 2. The proportion of fine and coarse aggregate.

3. The percentage of entrained air, within the allowable limits.
- B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified in Section 03350.

### 3.06 PLACING AND COMPACTING

#### A. Placing

1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, standing water, dirt, debris, and other foreign materials from forms and exposed joint surfaces. Confirm that reinforcement and other embedded items are securely in place. Have a worker at the location of the placement who can check that reinforcement and embedded items remain in designated locations and alignments while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Do not place concrete on frozen subgrade, snow, or ice.
2. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Place concrete continuously at a rate that allows the concrete previously placed to be integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes chosen for pumping and submit for approval. Do not use pipelines made of aluminum or aluminum alloy. When concrete is pumped, slump will be determined at point of truck discharge and air content will be determined at point of placement.
4. Remove temporary spreaders from forms when the spreader is no longer needed. Temporary spreaders may remain embedded in concrete only when made of galvanized steel or concrete and if prior approval has been obtained.
5. Do not place concrete for supported elements until concrete previously placed in the supporting element has attained design strength.
6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms to bring the full surface of the mortar against the form. Prevent the formation of surface voids.
7. Slabs
  - a. After bulkheads, screeds and jointing materials have been positioned, place concrete continuously between joints beginning at a bulkhead, edge form, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.

- b. Avoid delays in placement. If there is a delay in placement, spade and consolidate the concrete placed after the delay at the edge of the previously placed concrete to avoid cold joints. Bring concrete to correct level and strike off with a straightedge. Use bull-floats or darbies to smooth the surface, leaving it free of humps or hollows.
- c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow one hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist to prevent cold joints.

#### 8. Formed Concrete

- a. Place concrete in forms using tremie tubes taking care to prevent segregation. Maintain bottom of tremie tubes in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12-in to 24-in lifts, keeping the surface horizontal. If a high-range water-reducing admixture is used do not permit concrete to drop freely more than 15-ft; maximum lift thickness not to exceed 7-ft.

#### 9. Pads (Mass Concrete Placement)

- a. Care shall be taken during placement of concrete pads that exceed two (2) feet in thickness to ensure that internal temperatures are controlled to minimize internal stresses due to a high heat of hydration. CONTRACTOR shall attempt to pour such slabs/pads on cool days and follow applicable hot weather placing and curing procedures to keep the placed concrete cool. CONTRACTOR shall submit to the Engineer a work plan describing the methods and procedures proposed to use for mass concrete placement and curing. Mass concrete placement shall not begin until the work plan is acceptable to the Engineer.

#### 10. Bollards

- a. Conform to requirements specified above for formed concrete and completely fill pipe with concrete as indicated.

#### 11. Thrust Blocking and Anchor Collars

- a. Concrete for thrust blocks and anchor collars shall be placed against undisturbed soil. The excavation shall be hand shaped and free of loose material. Forms shall be used to confine the concrete in areas other than that part that is in contact with undisturbed soil in the direction of thrust.

### B. Compacting

- 1. Consolidate concrete by vibration and puddling, spading, rodding or forking so that concrete is completely worked around reinforcement, embedded items and openings and into corners of forms. Continuously perform puddling, spading, rodding and forking along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. Compact all concrete with mechanical vibrators. Do not order concrete until vibrators (including standby units in working order) are on the job.
3. Use mechanical vibrators having a minimum frequency of 8000 vibrations per minute. Insert vibrators and withdraw at points from 18-in to 30-in apart. Vibrate sufficiently at each insertion to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep standby vibrators on the site during concrete placing operations.
4. Concrete Slabs: Vibration for concrete slabs less than 8-in thick shall be by vibrating screeds. Vibration for concrete slabs 8-in and thicker shall be by internal vibrators and (optionally) with vibrating screeds. Place vibrators into concrete vertically. Do not lay vibrators horizontally or lay over.
5. Walls and Columns: Use internal vibrators (rather than form vibrators) unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down (level) the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. Insert vibrators vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Use vibrators to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:
  - a. Frequency of vibrator returns to normal.
  - b. Surface appears liquefied, flattened and glistening.
  - c. Trapped air ceases to rise.
  - d. Coarse aggregate has blended into surface but has not disappeared.

### 3.07 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods
  1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain a temperature of at least 50 Degrees F at the concrete surface for a minimum of seven days after placement. Use the following curing methods as specified:
    - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin water curing as soon as concrete attains an initial set and maintain water curing 24 hours a day. Do not permit the surface of the concrete to dry out at any time during the curing period. Temperature of curing water shall be within 20 Degrees F of the concrete temperature.

- b. Sheet Material Curing: Cover entire surface with sheet material. Anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
  - c. Liquid Membrane Curing: Apply over the entire concrete surface except as follows. Curing compound shall NOT be placed on any concrete surface where additional concrete or grout is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Apply curing compound as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Apply in compliance with the manufacturer's recommendations.
2. Specified applications of curing methods:
- a. Slabs for Liquid Retaining Structures: Water curing only.
  - b. Slabs on Grade and Footings (not used to retain liquids): Water curing, sheet material curing, or liquid membrane curing.
  - c. Structural Slabs (other than Liquid Retaining Structures): Water curing or liquid membrane curing.
  - d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
  - e. Formed Surfaces: None if nonabsorbent forms are left in place seven days. Water curing if absorbent forms are used. Water curing if forms are removed prior to seven days. Sheet cure or liquid membrane cure if forms are removed prior to seven days. Exposed horizontal surfaces of formed walls or columns shall be water cured for seven days or until next placement of concrete is made.
  - f. Surfaces of Concrete Joints: Water curing or sheet material curing.
  - g. Mass placements: Water curing or sheet material curing.
- C. Protect finished surfaces and slabs from the direct rays of the sun to prevent plastic cracking, checking and crazing. Do not apply additional water to the surface of concrete to facilitate finishing.
- D. Cold Weather Concreting
- 1. For this Specification, "cold weather" is defined as a period when for more than three successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate average daily temperature as the average of the highest and the lowest temperature during the period from midnight to midnight.
  - 2. Batch, deliver, place, cure and protect concrete during cold weather in compliance with the recommendations of ACI 306R and the additional requirements of this Section.

3. Review the cold weather concreting plan at the preconstruction meeting. Include the methods and procedures for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete and the procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
4. The minimum temperature of concrete immediately after placement and during the protection period shall be as indicated in Table 3. The temperature of the concrete in place and during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3

Concrete Temperatures  
Minimum Dimension of Section

	<u>&lt; 12-in</u>	<u>12 to 36-in</u>
Min. concrete temperature:	55 Degree F	50 Degree F

5. Protect concrete during periods of cold weather to provide continuous warm, moist curing (with supplementary heat when required by weather conditions) for a total of at least 350 degree-days of curing.
    - a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., 7 days at an average 50 degrees F = 350 degree-days).
    - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
  6. Do not use salt, manure or other chemicals for protection.
  7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, do not expose concrete to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated and air dry concrete for at least 3 days prior to first exposure to freezing temperatures.
  8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.
- E. Hot Weather Concreting
1. For this Specification, "hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 pounds per square foot per hour (lb/sq ft/hr).



2. Batch, deliver, place, cure and protect concrete during hot weather in compliance with the recommendations of ACI 305R and the additional requirements of this Section.
  - a. Temperature of concrete being placed shall not exceed 90 degrees F. Maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall not cause loss of slump, flash set or cold joints.
  - b. Promptly deliver concrete to the site and promptly place the concrete upon its arrival at the site, not exceeding the maximum time interval specified in Paragraph 3.02.1.4. Provide vibration immediately after placement.
  - c. The Engineer may direct the CONTRACTOR to immediately cover concrete with sheet curing material.
3. Review the hot weather concreting plan at the preconstruction meeting. Include the methods and procedures for use during hot weather including production, placement, and curing.

### 3.08 REMOVAL OF FORMS

- A. Do not remove forms before the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing (whichever is the longer):

TABLE 4

<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.07D).

- B. Do not remove shores until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and the construction live loads upon it.
- C. In cold weather, when temperature of concrete exceeds ambient air temperature by 20 Degrees F at the end of the protection period, loosen forms and leave in place for at least 24 hours to allow concrete to cool gradually to ambient air temperature.

### 3.09 FIELD AND LABORATORY TESTS

- A. Sets of field control cylinder specimens will be taken by the CONTRACTOR's testing laboratory during the progress of the work, in compliance with ASTM C31. Take field control cylinder specimens during the progress of the work, in compliance with ASTM C31, at the point of concrete placement. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 100 cu yds of concrete nor less than one set for each

5,000 sq ft of surface area for slabs or walls. Specimens shall be formed in 6-in diameter by 12-in long non-absorbent cylindrical molds.

1. A "set" of test cylinders shall consist of four cylinders: one to be tested at seven days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28-day test results are low.
  2. When the average 28 day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum seven-day strengths (where proper relation between seven and 28 day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths at no additional cost to the UTILITY.
  3. In the event that a set of field control cylinders are not collected on the day of concrete placement, a minimum of 3 cores shall be obtained and cured, per ASTM C42, 28 days after the concrete was placed and tested in accordance with ASTM C39 sampling standard, at no additional cost to the UTILITY. The location of the cores shall be specified by the engineer. Cores shall be of sufficient length to allow the upper 2" from each side of the cylinder to be removed and have an overall length to core diameter ratio of 2 to 1. Concrete core locations shall be repaired in accordance with Specification Section 03740.
- B. Cooperate in the making of tests by allowing free access to the work for the selection of samples. Provide four firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold eight specimens, complete with cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication until shipment to the testing lab. Protect the specimens against injury or loss through construction operations. Furnish material and labor required for the purpose of taking concrete cylinder samples.
- C. Slump tests will be made in the field by the CONTRACTOR's testing laboratory inspector immediately prior to placing the concrete. Such tests will be made in accordance with ASTM C143. Test slump immediately prior to placing the concrete. Test shall be made in accordance with ASTM C143. When concrete is pumped, slump will be determined at point of truck discharge. If the slump is outside the specified range, the concrete will be rejected. Slump tests shall be performed for every 30 cubic yards of each type of concrete placed each day including when test cylinders are made.
- D. Air Content: Test for air content will be made by the CONTRACTOR's testing laboratory inspector on a fresh concrete sample, at the point of concrete placement. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If aggregates with high absorptions are used, the latter test method shall be used. When concrete is pumped, air content will be determined at point of placement. Air content tests shall be performed for every 30 cubic yards of each type of concrete placed each day including when test cylinders are made.

### 3.10 FIELD QUALITY CONTROL

- A. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work. The right of the Engineer to take such cores shall not be construed as creating any obligation to take such cores, and not exercising this right to do so shall not relieve the CONTRACTOR from meeting the requirements of these Specifications.
- B. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes with non-shrink grout as specified in Section 03600. The work of cutting, testing and repairing the cores will be at the expense of the CONTRACTOR if defective work is uncovered. If no defective work is found, such cost will be at the expense of the UTILITY.

### 3.11 SPECIAL INSPECTION

- A. The UTILITY or the registered design professional in responsible charge acting as the UTILITY's agent shall employ one or more special inspectors to provide inspections during construction.
- B. Special inspection shall be performed in accordance with Section 1704.4 and table 1704.4 of the IBC.
- C. The Engineer shall be notified when the forms are complete and ready for inspection at least 12 hours prior to the proposed concrete placement.

### 3.12 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer may require changes in proportions or materials, or both, to apply to the remainder of the work in accordance with Paragraph 1.05E. Furthermore, the Engineer may require additional curing on those portions of the structure represented by the test specimens which fall below the values given in Table 1. The cost of such additional curing shall be at no additional cost to the UTILITY. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be at no additional cost to the UTILITY. In such cases of failure to meet strength requirements the CONTRACTOR and UTILITY shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in C94 is the CONTRACTOR.
- B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by obtaining a minimum of 3 cores drilled from the structure and cured, per ASTM C42, and tested in accordance with ASTM C39 sampling standard. In cases where tests of cores fall below the values

given in Table 1, the Engineer, in addition to other recourses, may require load tests on any one of the slabs, walls, beams, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days. The Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. All coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be at no additional cost to the UTILITY.

- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced at no additional cost to the UTILITY.

### 3.13 PATCHING AND REPAIRS

- A. It is the intent of these Specifications to require quality work including forming, mixture and placement of concrete and curing so completed concrete surfaces will require no patching or repairs.
- B. As soon as the forms have been stripped and the concrete surfaces exposed: remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- C. Immediately after removal of forms remove tie cones and metal portions of ties as specified in Section 03100. Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.
- D. When filling tie cone holes and patching or repairing exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color to match by addition of white cement. Rub lightly with a fine carborundum stone at an age of one to five days if necessary to bring the surface down with the parent concrete. Do not damage or stain the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.
- E. Defective concrete and honeycombed areas: Chip down square and at least 1-in deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8-in wide all around the steel. For areas less than 1-1/2-in deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2-in layers on successive days, each layer being applied (with slurry, etc.) as described above.
- F. For very heavy (generally formed) patches, the Engineer may order the addition of pea gravel to the mixture and the proportions modified as follows:

<u>Material</u>	<u>Volumes</u>	<u>Weights</u>
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

G. The CONTRACTOR may use a packaged patching compound, such as: Poly-Patch by Euclid Chemical Company; Emaco R310 by BASF Chemical Company; Sikatop 122 Plus by Sika Chemical Corporation or equal only if approved by the Engineer for use and for color match.

H. See also the requirements of Specification Section 03\_3750.

### 3.14 SCHEDULE

A. The following (Table 5) are the general applications for the various concrete classes and design strengths:

TABLE 5  
CONCRETE SCHEDULE

Class	Design Strength (psi)	Description
A	4,500	Walls, slab, slabs on grade, equipment pads, pavement, repair areas, thrust collars, and all other structural concrete
B	3,000	Concrete duct and pipe encasement, sidewalks, thrust blocking

END OF SECTION



SECTION 033500  
CONCRETE FINISHES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Formwork is included in Section 031000.
- B. Cast-In-Place Concrete is included in Section 033000.
- C. Modifications to Existing Concrete are included in Section 030001.
- D. Grout is included in Section 036000.
- E. Moisture Protection is included in Division 7.
- F. Painting, toppings and special surfaces are included in Division 9.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.
  - 2. Chemical hardener. Confirmation that the hardener is compatible with sealer shall also be submitted.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C33 - Standard Specification for Concrete Aggregates
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Finishes
  - 1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
  - 2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.
- B. Services of Manufacturer's Representative

1. Make available at no additional cost to the Owner, upon 72 hours notification, the services of a qualified field representative of the manufacturer of sealer or hardener to instruct the user on the proper application of the product under prevailing job conditions.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 FORMED SURFACES

- A. Forms shall not be removed before the requirements of Section 033000, have been satisfied.
- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or performing any other work adjacent thereto.
- C. Prepare the exposed surface as specified in Section 033000.
- D. Rough-Form Finish
  1. No additional finishing is required.
- E. Rubbed Finish
  1. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
  2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
  3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.).
  4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.
  5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient



- only to remove excess material without changing the texture of the concrete.
6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

## 3.2 FLOORS AND SLABS

### A. Floated Finish

#### 1. Machine Floating

- a. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in the proportion of two sacks of portland cement to 350 lbs of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 lbs/1,000 sq ft of floor. Do not sprinkle neat, dry cement on the surface.
- b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without its digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 lb compaction force distributed over a 24-in diameter disc.
- c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.
- d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

#### 2. Hand Floating

- a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-in indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.

### 3. Finishing Tolerances

- a. Level floors and slabs to a tolerance of plus or minus 1/8-in when checked with a 10-ft straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.

#### B. Broom Finish

1. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage, or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.

#### C. Steel Trowel Finish

1. Finish concrete as specified in Paragraph 3.2A. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.

### 3.3 APPROVAL OF FINISHES

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.
- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 033000 unless otherwise directed by the Engineer.

### 3.4 SCHEDULE OF FINISHES

- A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:
  1. Concrete to receive damp proofing or waterproofing: Rough-form finish. See Paragraph 3.1.D above.
  2. Concrete not exposed to view and not scheduled to receive an additional applied finish or material: Rough-form finish. See Paragraph 3.1.D above
  3. Exterior vertical concrete above grade exposed to view: Rubbed finish. See Paragraph 3.1.E above.
  4. Interior vertical concrete exposed to view except in water containment areas: Rubbed finish. See Paragraph 3.1.E above.
  5. Vertical concrete in water containment areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough-form finish on remainder of submerged areas. See Paragraphs 3.1.E and 3.1.D above.
  6. Interior and exterior underside of concrete exposed to view: Rubbed finish. See Paragraph 3.1.E above.
  7. Interior or exterior horizontal concrete not requiring floor hardener or sealer: Floated finish. See Paragraph 3.2.A above.
  8. Interior floor slabs of buildings: Steel trowel finish.

9. Concrete for exterior walks, interior and exterior stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.2.B above.
10. Concrete slabs on which process liquids flow or in contact with sludge: Steel trowel finish. See Paragraph 3.2.C above.
11. Concrete structure bottoms to be covered with grout: See Section 036000.
12. Concrete to be coated or painted: See Division 9.

END OF SECTION



## SECTION 033800

### CONCRETE JOINTS AND JOINT ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein.

##### 1.2 RELATED WORK

- A. DIVISION 03 – CONCRETE

##### 1.3 SUBMITTALS

- A. Submit, in accordance with Section 013300 "Submittal Procedures", shop drawings and product data. Submittals shall include the following:
  - 1. PVC Waterstops: Product data including catalog cut, technical data, storage requirements, splicing methods and conformity to ASTM standards.
  - 2. Preformed Non-Swelling Waterstops: Product data including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions and conformity to ASTM standards.
  - 3. Pre-molded joint fillers: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
  - 4. Bond breaker: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
  - 5. Compressible joint filler: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
  - 6. Bonding agents: Product data including catalogue cut, technical data, storage requirements product life, application requirements and conformity to ASTM standards.
- B. Certifications:
  - 1. Certification that all materials used within the joint system are compatible with each other.
  - 2. Certification that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

##### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
  - 2. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

3. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Non-extruding and Resilient Bituminous Types).
  4. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- B. U.S. Army Corps of Engineers (CRD):
1. CRD C572 - Specification for Polyvinylchloride Waterstops.
- C. Federal Specifications:
1. FS SS-S-210A - Sealing Compound for Expansion Joints.
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply unless otherwise noted.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic or bituminous bond breakers or joint fillers be used in joints receiving sealant.
- C. All waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

### 2.2 MATERIALS

- A. Preformed Non-Swelling Waterstops:
  1. Provide Synko-Flex® non-swelling preformed waterstop by Henry Company or approved equal.
- B. Pre-molded Joint Filler:
  1. Pre-molded joint filler - structures. Self-expanding cork, pre-molded joint filler shall conform to ASTM D1752, Type III. The thickness shall be  $\frac{3}{4}$  inch unless shown otherwise on the Drawings.
- C. Bond Breaker:
  1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the pre-molded joint filler or concrete surface as required. The tape shall be the same width as the joint unless otherwise noted.
  2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a non-staining type bond

prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 2000F, by SCA Construction Supply Division, Superior Concrete Accessories or approved equal.

D. Bonding Agent:

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881 (2002), Type V. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, N.J.; Concreative Liquid (LPL) by Master Builders of Cleveland, OH or approved equal.
2. Latex bonding agent shall be non-reemulsifiable acrylic-polymer latex conforming to ASTM C1059, Type II.

E. Joint Sealant:

1. Joint sealants shall be two-part urethane sealant as specified in Section 079200 "Joint Sealants". Minimum sealant thickness at concrete joints shall be 3/8 inch.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Preformed Non-Swelling Waterstops:

1. Install at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided.
2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified herein.
3. Prepare the joint surfaces, install primers or adhesives, and install expansive waterstops in accordance with the manufacturer's instructions.

B. Construction Joints:

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written approval.
2. Additional or relocated joints should be located where they least impair strength of the member.
3. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings.
4. Provide sealant grooves for joint sealant where indicated on the Drawings.
5. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.
6. Provide continuous keyways in construction joints unless noted otherwise on drawings.

C. Control Joints:

1. Provide sealant grooves, sealants and waterstops at control joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab control joints in water containment structures and at other locations shown on the Drawings.
2. Control joints at slabs on grade 6-in thick or less and without waterstops, may be sawed, if approved by the Engineer. If control joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during saw cutting.
3. Discontinue reinforcing steel through control joints in building slabs.

END OF SECTION



SECTION 036000  
GROUT

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Non-shrink grout for leveling column base plates, steel beams bearing on masonry, machinery and other equipment and/or accessories.

1.2 REFERENCES

- A. ASTM C33 - Concrete Aggregates.
- B. ASTM C109 - Compressive Strength of Hydraulic Cement Mortars.
- C. ASTM C230 - Flow Table for Use in Test of Hydraulic Cement.
- D. CRD-C-611 - Methods of Test for Flow of Grout Mixtures (Flow-Cone Method).
- E. CRD-C-621 - Specification for Non-Shrink Grout.

1.3 SUBMITTALS

- A. Procedures for Submittals: Section 013300 "Submittal Procedures".
- B. Product Data: Manufacturers product data sheets.
- C. Quality Control Submittals: For information only.
  - 1. Certification: Manufacturer's certification, or certified laboratory test reports, confirming that materials meet specification requirements.
  - 2. Installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver non-shrink grout to project site in unopened containers with manufacturer's labels intact.
- B. Store non-shrink grout material in dry shelter and protect from moisture.
- C. Containers that are torn or damaged such that non-shrink grout material has been exposed to elements shall be discarded.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Products of following manufacturers are acceptable subject to meeting specification requirements:
  - 1. Cormix Construction Chemicals (Gifford-Hill).
  - 2. Dayton Superior Corp.
  - 3. Euclid Chemical Co.

4. Five Star Products, Inc.
5. L&M Construction Chemicals.
6. Master Builders.
7. Symons.
8. Approved equal.

## 2.2 NON-SHRINK GROUT

- A. Qualities: Premixed non-metallic non-shrink grout material manufactured under rigid quality control, specially for use in transferring heavy loads.
1. Nonmetallic natural aggregate, non-staining and noncorrosive.
  2. Resist attack by oil and water.
  3. Minimum initial setting time of approximately one hour at 70F.
  4. Minimum compressive strength of 8,500 psi at 28 days when placed at a fluid consistency.
  5. Free of gas-producing or gas-releasing agents.
  6. Not greater than .04 expansion at 3, 14 and 28 days. Expansion at 28 days not less than expansion at 3 and 14 days.
- B. Standards:
1. Overall Product: CRD-C-621.
  2. Compressive Strength: ASTM C109, 2 inch cubes.
  3. Bleed Performance: CRD-C-611
  4. Flow Factor: ASTM C230.

## 2.3 RELATED MATERIALS

- A. Water: Potable.
- B. Pea Gravel: ASTM Size 8, Size 89
- C. Sand: ASTM C33

## 2.4 MIXING

- A. Mix materials in accordance with manufacturer's instructions.
- B. Mix as close to area to be grouted as possible. Provide adequate means to transport mixed grout as quickly as possible, and in manner to prevent segregation.
- C. No more grout shall be mixed at one time than can be placed in a period of 15 minutes. After grout has been mixed, do not re-temper by adding additional water.
- D. For less than a 4-inch clearance, or where size or shape of space makes grouting difficult, grout mix shall consist of grout material and water.
- E. For greater than 4-inch clearances where coarse aggregate will not obstruct free passage of grout, grout may be extended by adding clean pea gravel if allowed or recommended by the grout manufacturer. Follow manufacturer's recommendation for maximum amount of pea gravel that may be added to mixture.
- F. Use minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.

## PART 3 - EXECUTION

### 3.1 PROCEDURES

- A. Installation methods and procedures shall conform to the printed instructions of the grout manufacturer and these Specifications. Where there is a conflict between these Specifications and the printed instructions of the grout manufacturer, the printed instructions of the grout manufacturer shall take precedence.

### 3.2 PREPARATION

- A. Remove defective concrete, dirt, oil, grease, and other foreign material from concrete surfaces by bush-hammering, chipping or other similar means, until a sound clean concrete surface is achieved.
- B. Lightly roughen concrete, but not enough to interfere with proper placement of grout.
- C. Remove foreign materials from surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted. Coat shim with a thin film of grease or wax to facilitate removal.
- E. Provide relief holes to avoid trapping air beneath base plates.
- F. Take special precautions during extreme weather conditions according to the manufacturer's written instructions.
- G. Saturate concrete surfaces with clean water for period of time specified by manufacturer. Remove excess water just prior to grouting.
- H. Immediately prior to grouting, clean surfaces free of contaminants.

### 3.3 FORMWORK

- A. Build leak proof forms that are strong and securely anchored and shored to withstand grout pressures. Build forms high enough to provide a "head" of grout where it is required to force grout into difficult locations.
- B. Provide enough clearance between formwork and areas to be grouted to permit proper placement of grout.

### 3.4 PLACING

- A. Place grout in accordance with manufacturer's instructions.
- B. Place non-shrink grouting material quickly and continuously by most practical means permissible; pouring, pumping or under gravity pressure. Do not use either pneumatic-pressure or dry packing methods without authorization of Engineer.
- C. When practical, apply grout from one side only to avoid entrapping air.
- D. Final installation shall be thoroughly compacted and free from air pockets. To facilitate placement, a 2 to 1 inch chain or metal strap may be pulled back and forth under the equipment during grouting. Remove chain or strap before initial set takes place.

- E. Do not vibrate, place grout mixture, or allow it to be placed if area is being vibrated by nearby equipment, except when approved by grout manufacturer.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed. After shims have been removed, fill voids with non-shrink grout.

### 3.5 CURING

- A. Cure grout for three (3) days at temperatures greater than 50°F after placing by keeping wet and covering with curing paper, by coating with a concrete membrane-forming curing compound, or by other approved methods.

END OF SECTION

SECTION 042200  
CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 GENERAL

- A. Regular concrete masonry units (CMUs).
- B. Reinforcement, anchorages, and accessories.
- C. Masonry-cell insulation.
- D. Cavity wall insulation.

1.2 RELATED SECTIONS

- A. Section 042201 – Integral Water-Repellant Admixture for CMUs
- B. Section 042202 – Integral Water-Repellant Admixture for Mortar

1.3 REFERENCES

- A. ASTM A82 - Cold-Drawn Steel Wire for Concrete Reinforcement.
- B. ASTM A116 - Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric.
- C. ASTM C90 - Hollow Load-Bearing Concrete Masonry Units.
- D. ASTM C144 - Aggregates for Masonry Mortar.
- E. ASTM C150 - Portland Cement.
- F. ASTM C207 - Hydrated Lime for Masonry Purposes.
- G. ASTM C270 - Mortar for Unit Masonry.
- H. ACI 530.1 - Specification for Masonry Structures

1.4 SUBMITTALS

- A. Submit in accordance with Section 013300 "Submittal Procedures".
- B. Concrete Block: Illustrate color, texture, and extremities of color range.
- C. Product Data: Manufacturer's data for the following:
  - 1. Masonry accessories
  - 2. Masonry cell Insulation
- D. Certificates: Manufacturer's certificate that masonry unit materials meet or exceed specified requirements and those of the referenced standards. Provide compression strength tests for concrete blocks and bricks to be used.

- E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
- F. Compressive strength tests for mortar trial mix with components submitted.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

#### 1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

## PART 2 - PRODUCTS

### 2.1 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water-Repellent: Provide units made with integral water-repellent for exterior walls, and exterior veneer. Refer to Section 042201 "Water-Repellent for CMU's".
- C. Regular Masonry Units: Used for exterior walls.
  - 1. Modular sized to 8 x 16 inch face dimension, thickness as shown.
  - 2. Coordinate with Drawings and details for other sizes/shapes as required.
  - 3. Hollow Load Bearing Units: ASTM C90, Grade N, Type I; lightweight.
  - 4. Standard pattern, split face finish on outside.
  - 5. Color: Standard.
- D. Size of units and wall thickness shall be as detailed on the Drawings. All masonry units shall be first quality units, free from flaws, stains, cracks, chips, or rocks that might interfere with the proper setting of the unit, or impair the strength or appearance of the masonry walls. All blocks exposed in the finished work shall have the same uniform texture.

### 2.2 REINFORCEMENT

- A. Horizontal Reinforcement (Bond Beams as indicated on the Drawings)
  - 1. Bond Beams and Lintel Beams shall be reinforced as detailed with ASTM A615 grade 60 steel and filled with grout as specified herein. **DO NOT USE MASONRY MORTAR FOR THIS PURPOSE.**
- B. Horizontal Mortar Joint Reinforcement (as shown on drawings)
  - 1. Standard weight masonry wall reinforcement, as noted on the Drawings, shall be hot-dipped galvanized ASTM A153, Class B-2, Class 1, ladder-type with 9 gauge side rods and cross ties; spaced as shown on the Drawings. Include prefabricated corners and intersection. Sized for wall thickness. Lap a minimum of 12" at ends.
  - 2. Heavy-duty masonry wall reinforcement, as noted on the Drawings, shall be hot-dipped galvanized ASTM A153, Class B-2, Class 1, ladder-type with 3/16 inch diameter side rods and 9 gauge cross rods; spaced as shown on the Drawings. Provide pre-fabricated corners and intersection. Sized for wall thickness. Lap a minimum of 16" at ends.
  - 3. Masonry wall reinforcement shall be used in the construction of all walls of lightweight concrete block, or any combination of masonry units.
- C. Vertical reinforcement, as shown on the Drawings, shall be provided for all masonry construction. Vertical cores shall be reinforced as detailed with ASTM A615 grade 60 steel and filled with grout as specified herein

## 2.3 ANCHORAGES

- A. Masonry anchors and ties shall be copper coated or zinc coated steel or of a non-corrosive metal having equivalent ultimate strength of the types noted below.
- B. Zinc coating of anchors and ties shall conform to ASTM A153, Class B-1, -2, or -3.
- C. Zinc coated wire shall conform to ASTM A116, Class 2.
- D. Copper coated wire shall conform to ASTM B227, Grade 30 HS.
- E. Wire-mesh ties shall be equivalent to 0.0625 inch nominal diameter (16 gauge) steel wire, 2-inch mesh, 3-inches wide.
- F. Reinforcing bars shall conform to the requirements of Section 032000 "Concrete Reinforcement" of these Specifications.

## 2.4 BOND & LINTEL BEAMS

- A. Bond Beams and Lintel Beams shall be reinforced as detailed with ASTM A615 grade 60 steel and filled with grout as specified herein. **DO NOT USE MASONRY MORTAR FOR THIS PURPOSE.** Provide standard channel shaped masonry units to form bond beams over openings and hollow bottom bond beam units elsewhere, unless otherwise shown on the Drawings.

## 2.5 MORTAR AND GROUT MATERIALS

- A. Grout
  - 1. All reinforced cells of block walls shall be fully grouted and have reinforcing bars sized, spaced, and located as shown on the Drawings.
  - 2. Grouting of vertical and horizontal cells shall meet ACI 530.1.
  - 3. Grout shall conform with ASTM C476.
  - 4. Submit mix design for approval per 033000.
  - 5. Masonry mortar will not be used for this purpose.
  - 6. Sample and test grout in accordance with ASTM C1019.
- B. Mortar
  - 1. Mortar and mortar materials shall conform to ASTM C270.
  - 2. Mortar for exterior and bearing wall work shall be composed of a 1/2:1:4-1/2 mix of an approved masonry cement (Type II) and sand, or a 1:1/2:4-1/2 mix of Type "N", hydrated lime or lime putty, and sand, Type "S".
  - 3. Mortar for interior partition wall work shall be composed of a 1:3 mix of masonry cement and sand; or a 1:1/2:4-1/2 mix of Portland cement, hydrated lime, and sand. Type "N".
  - 4. Mortar shall be proportioned by weight as specified above.
  - 5. The weight of one cubic foot of the respective materials shall be considered as the following:
    - a. Portland Cement: 94 lb.
    - b. Masonry Cement: Weight printed on bag
    - c. Hydrated Lime: 40 lb.



- d. Lime Putty: 40 lb.
- e. Sand, Damp and Loose: 1 cu. ft. contains 80 lb of dry sand
- 6. The method of measuring materials for mortar shall be such that the specified proportions can be controlled and accurately maintained during the entire progress of the work.
- 7. Cementitious materials and aggregate shall be mixed with the minimum amount of water consistent with satisfactory workability for a minimum period of 3 minutes in a drum type batch mixer.
- 8. Mortar shall be mixed with integral water-repellent, see Section 042202 "Water-Repellent for Mortar".
- 9. Pre-mixed mortar materials meeting specified types may be used. Provide certified laboratory test data for compressive strength and mortar type.

## 2.6 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces.
- B. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned
  - 1. Available Manufacturers:
    - a. Diedrich Technologies, Inc.
    - b. EaCo Chem, Inc.
    - c. Approved equal.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate metal anchors with appropriate specification sections for placement. Direct correct placement.
- B. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- C. Verify items provided by other Sections of work are properly located.
- D. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.
- E. Do not lay masonry in freezing weather unless suitable means are provided to heat materials, protect work from frost, and insure that mortar will harden and cure without freezing.
- F. No anti-freezing ingredients shall be used without prior Engineer approval.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build walls and other masonry construction to full thickness shown. Build single-width walls to actual widths of masonry units, using units of widths indicated.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- E. Comply with construction tolerances in ACI 530.1 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet maximum.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 3 inches in 10 feet maximum.
  - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet maximum.
  - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus c inch, with a maximum thickness limited to 2 inches.
  - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
  - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
  - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond as shown on the Drawings. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- F. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

### 3.5 BONDING AND ANCHORAGES

- A. All corners and intersections of masonry walls and partitions shall be bonded in each course and shall be bonded or anchored to connecting work.

### 3.6 GROUTING

- A. Reinforcing steel and anchors shall be set into required position and secured against displacement before grouting is started.
- B. Place grout in such a way as to prevent segregation of materials.
- C. Pour grout fluid enough to flow into all crevices of grout spaces leaving no voids.
- D. Grout beams over openings in one continuous operation.
- E. Stop grout pours 1-1/2 inches below a mortar joint, except at top of wall.

- F. Where bond beams are used stop grout pour 2 inches below top.
- G. Use metal lath, mortar, or special units to confine grout to area required.
- H. Remove misplaced grout immediately and clean affected areas.

### 3.7 CURING

- A. Rapid drying of masonry work will not be permitted. The Contractor shall keep the masonry moist, by whatever means necessary until the mortar has set thoroughly.

### 3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.9 CLEAN UP

- A. Upon completion of all work in this section, promptly remove from the job site all mortar droppings, broken units, debris arising from the work of this Section, and all tools and equipment leaving all areas in a neat and orderly condition to the approval of the Engineer.

### 3.10 PAINTING

- A. Painting shall be in accordance with Section 099000 "Painting".

END OF SECTION

## SECTION 042201

### INTEGRAL WATER-REPELLENT ADMIXTURE FOR CMUs

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes liquid polymeric admixture added to the concrete masonry units at the time of manufacture.

##### 1.2 RELATED SECTIONS

- A. Section 042200 - Concrete Masonry Units
- B. Section 042202 - Integral Water-Repellent Admixture for Mortar

##### 1.3 SUBMITTALS

- A. Submit in accordance with Section 013300 "Submittal Procedures".

##### 1.4 WARRANTY

- A. Integral CMU water-repellent admixture shall be warranted by admixture manufacturer to be free of defects and to meet manufacturer's published physical and chemical properties.
- B. CMU producer shall warrant that integral CMU water-repellent admixture has been provided at appropriate dosage rate in all CMU units shipped to project site for use in exterior wall construction.
- C. Installer shall warrant that only CMUs containing integral CMU water-repellent admixture have been placed in exterior CMU walls.

#### PART 2 - PRODUCTS

##### 2.1 INTEGRAL CMU WATER-REPELLENT

- A. Description: Integral liquid polymeric admixture mixed with concrete during production of CMUs.
- B. Water Permeance of Masonry: Capable of achieving a Class E Rating when evaluated using ASTM E514 with the test extended to 72 hours, using the rating criteria specified in ASTM E514.
- C. Flexural Bond Strength of Masonry: An increase of minimum 10% in masonry flexural bond strength shall occur as a result of adding integral water-repellent CMU and mortar admixtures when compared to a control (containing no admixtures) CMU and mortar tested according to ASTM C1357.

- D. Compressive Strength of Masonry Prisms: Maximum 5% decrease in compressive strength of prisms shall occur as a result of adding integral water-repellent CMU and mortar admixtures when compared to a control (containing no admixtures) CMU and mortar when tested according to ASTM C1314.
- E. Drying Shrinkage of CMU: Maximum 5% increase in drying shrinkage of the CMU shall occur as a result of adding integral water-repellent CMU admixture when compared to a control (containing no admixtures) CMU when tested according to ASTM C426.
- F. Product: DRY-BLOCK Block Admixture manufactured by Grace Construction Products, or approved equal.

## PART 3 - EXECUTION

### 3.1 INTEGRAL WATER-REPELLENT CMU

- A. Installer shall use only mortar containing compatible integral liquid polymeric water-repellent mortar admixture at the manufacturer's recommended addition rate and mixed according to manufacturer's recommended instructions for construction of water-repellent CMU exterior walls.

### 3.2 CLEANING

- A. Remove "primary" efflorescence from masonry walls exposed in the finished work in accordance with the manufacturer's recommendations and the National Concrete Masonry Association (NCMA) TEK Bulletin #8-3A.
- B. Remove dirt or stains from masonry walls exposed in the finished work in accordance with the manufacturer's recommendations and the NCMA TEK Bulletin.
- C. Promptly remove excess wet mortar containing integral water-repellent mortar admixture from the face of the masonry as work progresses. Do not use strong acids, overaggressive sandblasting or high-pressure cleaning methods.

END OF SECTION

## SECTION 042202

### INTEGRAL WATER-REPELLENT ADMIXTURE FOR MORTAR

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes liquid polymeric admixture added to the mortar for wall construction at the time of mixing.

##### 1.2 RELATED SECTIONS

- A. Section 042200 - Concrete Masonry Units.
- B. Section 042201 - Integral Water-Repellent Admixture for CMUs.

##### 1.3 SUBMITTALS

- A. Submit in accordance with Section 013300 "Submittal Procedures".

##### 1.4 STORAGE

- A. Store integral water-repellent mortar admixture in an area where temperature is maintained between 40F to 100F. Do not allow integral water-repellent mortar admixture to freeze; discard frozen admixture.

##### 1.5 WARRANTY

- A. Integral water-repellent mortar admixture shall be warranted by admixture manufacturer to be free of defects and to meet manufacturer's published physical and chemical properties.
- B. Installer shall warrant that only mortar containing integral water-repellent mortar admixture at the manufacturer's recommended addition rate has been placed in exterior walls.

#### PART 2 - PRODUCTS

##### 2.1 INTEGRAL WATER-REPELLENT MORTAR ADMIXTURE

- A. Description: Integral liquid polymeric admixture for mortar added during mixing.
- B. Water Permeance of Masonry: Capable of achieving a Class E Rating when evaluated using ASTM E514 with the test extended to 72 hours, using the rating criteria specified in ASTM E514.
- C. Flexural Bond Strength of Masonry: An increase of minimum 10% in masonry flexural bond strength shall occur as a result of adding integral water-repellent CMU and mortar admixtures when compared to a control (containing no admixtures) CMU and mortar when tested according to ASTM C1357.
- D. Compressive Strength of Masonry Prisms: Maximum 5% decrease in compressive strength of prisms shall occur as a result of adding integral water-repellent CMU and

- mortar admixtures when compared to a control (containing no admixtures) CMU and mortar when tested according to ASTM C1314.
- E. Drying Shrinkage of Mortar: Max. 5% increase in shrinkage of mortar shall occur as a result of adding integral water-repellent mortar admixture when compared to a control (containing no admixture) mortar when tested according to ASTM C1148.
  - F. Product: DRY-BLOCK Mortar Admixture manufactured by Grace Construction Products, or approved equal.

## PART 3 - EXECUTION

### 3.1 INTEGRAL WATER-REPELLENT MORTAR ADMIXTURE

- A. Installer shall use only concrete masonry units containing compatible integral water-repellent CMU admixture for exterior wall construction.
- B. Installer shall use only mortar containing integral water-repellent mortar admixture at the manufacturer's recommended addition rate and mixed according to the manufacturer's recommended instructions.
- C. Fill head and bed joints for full thickness of the faceshells to provide the greatest resistance to water penetration.

### 3.2 CLEANING

- A. Remove "primary" efflorescence from masonry walls exposed in the finished work in accordance with the manufacturer's recommendations and the National Concrete Masonry Association (NCMA) TEK Bulletin #8-3A.
- B. Remove dirt or stains from masonry walls exposed in the finished work in accordance with the manufacturer's recommendations and the NCMA TEK Bulletin.

END OF SECTION



## SECTION 05 5000

### MISCELLANEOUS METALS AND MATERIALS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to complete and install fabricated metal items and furnish all supplementary items necessary for their proper installation. Miscellaneous metal items include, but are not limited to, the following:
  - 1. Embedded steel plates and miscellaneous embedded metal assemblies.
  - 2. Anchors and anchor bolts, except those specified to be furnished under equipment specifications.
  - 3. Metal pipe supports per the Drawings
- B. Check Drawings carefully and furnish all anchors, sleeves, bolts, brackets, clips, inserts, angles, loose lintels, tubing, bar stock, plates, and other miscellaneous metal and materials not distinctly specified under other Sections but necessary to complete the work.

##### 1.02 RELATED WORK

- A. Concrete reinforcement and concrete accessories are included in Division 3.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data, in accordance with Section 01\_3000, showing materials of construction and details of installation. Submittals shall include at least the following:
  - 1. Shop drawings, erection drawings, product data, etc., showing methods of assembly, anchorage, and connection to other members. Shop drawings will be required for all items included under this Section, unless otherwise noted.
- B. Samples
  - 1. Samples of products prior to construction, if requested by the Engineer.
- C. Submit product information for specific items indicated below and as selected for use in construction including, but not limited to:
  - 1. Post-installed concrete anchors
  - 2. Cast-in-place concrete anchors
  - 3. Dowel adhesive for post-installed anchors and reinforcing bars
- D. Certifications
  - 1. Certified material test reports for materials supplied and certification that materials meet the specified standards: for all shop fabrications, excluding prefabricated components.
  - 2. Welder's certifications, if requested by the Engineer.

## 1.04 REFERENCE STANDARDS

### A. Aluminum Association

1. Aluminum Design Manual
2. Specifications for Aluminum Structures
3. Engineering Data for Aluminum Structures
4. AA M31C22A41
  - a. M31: Mechanical Finish, Fine Satin
  - b. C22: Finish, Medium Matte
  - c. A41: Clear Anodic Coating, Class I

### B. American Institute of Steel Construction (AISC)

1. Manual of Steel Construction, 13<sup>th</sup> Edition

### C. American National Standards Institute (ANSI)

1. ANSI A14.3 - Standard for Ladders-Fixed-Safety Requirements

### D. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
4. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
7. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Plate, Sheet, and Strip Pressure Vessels.
8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

12. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts
13. ASTM A992 - Standard Specification for Structural Shapes
14. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
16. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
17. ASTM F436 - Standard Specification for Hardened Steel Washers
18. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
19. ASTM F594- Standard Specification for Stainless Steel Nuts
20. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
21. ASTM E94 - Standard Guide for Radiographic Examination
22. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments
23. ASTM E165 - Standard Test Method for Liquid Penetrant Examination
24. ASTM E709 - Standard Guide for magnetic Particle Testing

E. American Welding Society (AWS)

1. AWS A2.0 - Standard Welding Symbols
2. AWS D1.1 - Structural Welding Code - Steel
3. AWS D1.2 - Structural Welding Code – Aluminum

F. Occupational Safety and Health Administration (OSHA)

G. 2006 International Building Code (IBC).

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply or the edition as specified in the International Building Code shall be used.

1.05 COORDINATION

- A. Coordinate completely the work of this Section with the work of other Sections. Verify at the site both the dimensions and work for other trades adjoining items of work in this Section before fabrication and installation of the items specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Deliver anchorage devices with setting drawings, templates, and instructions for installation.

- C. Store delivered items off the ground and protected from dirt and weather.
- D. Protect items to be incorporated into the work against scratching, splashes, mortar, paint, and other damage during transportation, storage, installation, and until adjacent work by other trades is complete.
- E. Repair items that have become damaged or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

1.07 QUALITY ASSURANCE

- A. See additional inspection and testing requirements as provided in Section 3.02.

PART 2 PRODUCTS

2.01 STEEL AND IRON FABRICATIONS

A. Steel and Iron

- |                                   |   |
|-----------------------------------|---|
| 1. Structural Steel               | ASTM A36  |
| 2. Structural Steel Tubing        | ASTM A500, Grade B  |
| 3. Welded and Seamless Steel Pipe | ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work |
| 4. Steel Sheets                   | ASTM A1008  |
| 5. Gray Iron Castings             | ASTM A48, Class 35  |
| 6. Ductile Iron Castings          | ASTM A536, Grade 65-45-12   |
| 7. Galvanizing                    | ASTM A123, Zn w/0.05 percent minimum Ni   |
| 8. Galvanizing, hardware          | ASTM A153, Zn w/0.05 percent minimum Ni   |

B. Fabrication

- 1. See general fabrication requirements in Article 2.11.
- 2. Steel construction shall conform to the AISC Manual of Steel Construction, unless otherwise noted.
- 3. Welding and welding electrodes shall be in accordance with AWS D1.1, unless otherwise noted. Provide Type E70XX low-hydrogen electrodes, unless otherwise specified. Minimum fillet weld size shall be 1/4-in unless otherwise noted.
- 4. Connection bolts for structural framing shall be 3/4-in diameter A325 bolts, two bolts minimum, unless otherwise noted.
- 4. Fabricate miscellaneous steel shapes and plates as shown, including: beams, angles, support brackets, anchor bolts, and any other miscellaneous steel called for on the Drawings and not otherwise specified.

5. Finishes

- a. All embedded steel items and all steel elements supporting masonry or veneer shall be hot-dip galvanized, unless otherwise noted.
- b. Galvanizing shall be done after fabrication.
- c. Thoroughly clean steel fabrications of all loose mill scale, rust, grease or oil, moisture, dirt, or other foreign matter and finish in compliance with Division 9 or.

2.02 STAINLESS STEEL FABRICATIONS

A. Materials

1. Stainless Steel Plates, Sheets, and Structural Shapes

- a. Exterior, Submerged or Industrial Use                      ASTM A276, Type 316 (Type 316L for welded)
  - b. Interior and Architectural Use                                      ASTM A276, Type 304
2. Stainless Steel Bolts, Screws and Studs                      ASTM F593 CW (Type 316)
3. Stainless Steel Nuts    ASTM F594 (Type 316)
4. Stainless Steel Washers    ASTM A240 (Type 316)

B. Fabrication

- 1. See general fabrication requirements in Article 2.11.

2.03 ALUMINUM FABRICATIONS

A. General

- 1. Aluminum alloy designations shall be in accordance with the designations of the Aluminum Association.

B. Materials

- 1. Aluminum Extruded Pipe    ASTM B429, Alloy 6063 T6
- 2. Aluminum Extruded Shapes    ASTM B221, Alloy 6061 T6
- 3. Aluminum Sheet and Plate    ASTM B209, Alloy 6061 T6

C. Fabrication

- 1. See general fabrication requirements in Section 2.11.
- 2. Aluminum construction shall conform to the standards and specifications of the Aluminum Association, unless otherwise noted.
- 3. Fabricate miscellaneous aluminum shapes and plates as shown. Furnish all miscellaneous aluminum shown but not otherwise detailed. Structural shapes and extruded items shall comply with the dimensions on the Drawings within the tolerances published by the Aluminum Association.

4. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration of exposed aluminum surfaces.
5. Use appropriate weld filler material as required by the Aluminum Design Manual for respective aluminum alloys.
6. Finishes
  - a. All exposed aluminum surfaces shall have fabricator's standard mill finish unless otherwise specified.

#### 2.04 ANCHORS, BOLTS, AND FASTENING DEVICES

A. Furnish anchors, bolts, fasteners, etc., as necessary for installation for the work of this Section or as specified for securing the work of other Sections.

B. Materials

- |  |   |
|--|---|
| 1. Carbon Steel Bolts and Studs                | ASTM A307, Grade A (hot dip galvanized nuts and washers where noted), ASTM A108, or ASTM F1554, Grade 36 - Standard headed anchor bolts |
| 2. Carbon Steel Nuts                           | ASTM A563   |
| 3. Carbon Steel Washers (Grade A, Hex, UNO)    | ASTM F436   |
| 4. High Strength Steel Bolts, Nuts and washers | ASTM A325 (mechanically galvanized per ASTM B695, Class 50, where noted)  |
| a. Elevated Temperature Exposure               | Type I  |
| b. General Application                         | Type I or Type II   |

C. Fasten aluminum and stainless-steel members utilizing Type 316 stainless steel machine bolts. Fasten iron or steel members utilizing steel machine bolts, unless otherwise noted. Galvanized steel members shall be fastened utilizing galvanized steel or zinc-plated fasteners, unless otherwise noted.

D. Unless otherwise noted, drilled concrete anchors shall be adhesive type or expansion type anchor bolts as specified below:

1. Adhesive anchors shall consist of a metal stud assembly and a two-component resin anchoring system. Chemical resins shall be polyester or vinylester resin, combined with a hardener and aggregates, as applicable. Stud assemblies shall consist of an all-thread anchor rod with nut and washer, unless otherwise noted on the Drawings. Provide manufacturer's recommended installation tools for installing anchor components. Install anchors in full compliance with the manufacturer's recommendations.
  - a. Adhesive anchors shall be: HIT RE 500 SD or HIT HY 150 MAX SD (seismic applications) as manufactured by Hilti, Inc., or approved equal. Anchor rods shall be of the size and type designated on the Drawings. Where specifically indicated on the Drawings, the adhesive anchoring system noted shall be used; no substitutions.
2. Expansion anchors shall be wedge type anchors of the sizes and minimum embedment as noted on the Drawings, complete with nuts and washers. Embedment depth, side over,

and spacing shall be in accordance with the manufacturer's recommendations and as shown on the Drawings.

- a. Expansion anchors shall be: "Kwik Bolt TZ Expansion Anchors" as manufactured by Hilti, Inc., or approved equal. These anchors shall be used when anchoring into new or existing concrete construction.
  - b. Expansion anchors shall be: "Kwik Bolt III Expansion Anchors" as manufactured by Hilti, Inc., or approved equal. These anchors shall be used when anchoring into new or existing grouted masonry construction.
3. Anchors used in masonry construction shall be as indicated in Section 2.04.E.2.b above where anchors are installed into grouted cells. Additionally, Hilti HY 150 adhesive anchoring system, or approved equal, may also be used in grouted masonry construction. Where anchors are installed in hollow cells, adhesive anchors shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT C-20 System or equal.
- E. Headed anchor studs shall be Nelson Type H4L or S3L, unless otherwise noted, by Nelson Stud Welding Company, or equal. Studs shall be welded per the manufacturer's recommendations and in accordance with AWS D1.1.
- F. Compound masonry anchors shall be of the "two unit" type and shall be Star Slugin anchors as manufactured by Star Expansion Industries; equal by Phillips Drill Co.; or The Rawlplug Co.; or equal.
- G. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- H. Toggle bolts shall be by Diamond; Keystone; Star; or equal.
- I. Embedded anchor bolts shall be 5/8-in diameter (minimum), unless otherwise noted. Protect the exposed portions of embedded anchor bolts during concrete placement.
- 2.05 NOT USED
- 2.06 NOT USED
- 2.07 NOT USED
- 2.08 NOT USED
- 2.09 MISCELLANEOUS STEEL
- A. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.
  - B. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.
  - C. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be galvanized.

- D. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- F. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface. See Specification Section 05910 for additional information regarding galvanizing.

#### 2.10 MISCELLANEOUS STAINLESS STEEL

- A. Miscellaneous stainless-steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

#### 2.11 FABRICATION - GENERAL

- A. Form all miscellaneous metal work true to detail, with clean, straight, sharply defined profiles, tight joints, and smooth surfaces of uniform color and texture. Provide fabrications free from defects impairing strength or durability. Drill or punch holes and smooth edges. Ease exposed edges to a small, uniform radius. Fabricate supplementary pieces necessary to complete each item even though such pieces are not specifically shown or specified.
- B. Supply components required for anchorage of fabrications. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Steel accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fittings.
- C. Welded joints shall be rigid and continuously welded unless otherwise specified or shown. Dress the face of welds flush and smooth. Continuously weld and grind smooth welds that will be exposed. Exposed joints shall be close fitting and jointed where least conspicuous. Conceal fastenings where practical. Punch or drill for temporary field connections and for attachment of the work of other trades.
- D. Welding of parts shall be in compliance with the latest edition of AWS D1.1 or AWS D1.2 as applicable, and shall only be done where shown, specified, or permitted by the Engineer. Welding shall be performed only by welders certified to perform the required welding in compliance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.
- E. Where indicated, pipe penetrations in existing construction shall be core drilled and sealed with mechanical seals (Link Seals) or equivalent.

### PART 3 EXECUTION

#### 3.01 INSTALLATION - GENERAL

- A. Install all items furnished in accordance with this Section, except items to be embedded in concrete that shall be installed under Division 3. Items to be attached to concrete after such work is completed shall be installed in compliance with the details shown. Furnish to appropriate trades all anchors, sockets, or fastenings required for securing work to other construction.
- B. Set metal work level, true to line, and plumb, as indicated.
- C. Weld field connections and grind smooth where practical. Clean and strip primed steel items to bare metal where field welding is required. Conceal fastenings where practical.



- D. Touch-up abrasions to finish or primer coatings immediately after erection and prior to both final coating and final acceptance.
- E. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- F. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.
- G. Install adhesive capsule anchors using manufacturer's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- H. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.
- I. All railings shall be erected to line and plumb.
- J. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- K. Break contact between dissimilar metals as shown on the Drawings or as specified in paragraph 3.01L and M.
- L. Field or shop apply coatings for installation of metal fabrications according to the following schedule. For embedded items, coat the embed.
  - 1. All unbonded steel surfaces in contact with exposed concrete or masonry shall receive a protective coating of an approved epoxy paint as specified in Division 9, applied in compliance with the manufacturer's instructions prior to installation.
  - 2. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal. Alternately, where approved, provide neoprene isolator pads, 1/4-in thick, 85 durometer plus or minus 5 durometers, Shore A hardness, sized for full width and length of connection.
  - 3. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
  - 5. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
  - 6. Steel, equipment & piping subject to wastewater immersion or splash above wastewater stream shall be prepared according to SSPC-SP5 White Metal Blast Cleaning, with one coat of Tnemec Series N69/N69F HB Epoxoline at 4 to 6 mils DFT.
  - 5. Field paint exposed metal surfaces as specified in Division 9, Painting.
- M. Between aluminum gratings, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 durometer plus or minus 5 durometer, Shore A hardness, sized for full width and length of bracket or support.

### 3.02 FIELD INSPECTION/QUALITY CONTROL

- A. The UTILITY or the registered design professional in responsible charge acting as the UTILITY's agent shall employ one or more special inspectors to provide inspections during construction.
- B. After arrival on-site and prior to installation, inspect all received materials including bolts, structural steel, aluminum grating, aluminum structural shapes, ladders, stairs, and all other

items referenced in the specification to ensure that materials received are as specified herein, on the drawings, and that they comply with all referenced standards.

C. Structural Inspections (Fabricators):

1. Special inspection of fabricators shall be performed in accordance with Section 1704.2 of the IBC.

D. Structural Inspections (Construction):

1. Special inspection of steel construction shall be performed in accordance with Section 1704.3 and table 1704.3 of the IBC.

E. Structural Inspections (Welding):

1. All field welding will be inspected visually by AWS certified welding inspectors provided by the UTILITY. Additional non-destructive testing may be required at the discretion of the welding inspector and based upon observations made during visual inspection in which weld adequacy or strength is in question. Follow AWS standards/guidelines for non-destructive testing procedures at the discretion of the welding inspector. Comply with all requests of inspectors to correct deficiencies. The following non-destructive tests are allowed and shall be used at the discretion of the welding inspector:
2. Liquid Penetrant Inspection: ASTM E165.
3. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
4. Ultrasonic Inspection: ASTM E164.
5. Radiographic Inspection: ASTM E94.

F. All post-installed concrete anchors shall be inspected to ensure compliance with the manufacturer's recommended installation instructions, indicated bolt size, and embedment as shown on the Contract Drawings. Inspection services shall be provided by an independent inspector employed by the UTILITY.

1. Test a minimum of 5%, or as directed by the UTILITY under consultation of the employed independent inspector, of each type and size of drilled-in anchor in each substrate they are installed. Drilled-in anchors shall be proof loaded by the independent testing laboratory employed by the UTILITY. Adhesive anchors and capsule anchors, if applicable, shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve 1.5 times the expected allowable design loads per the manufacturer, all anchors of the same diameter, embedment, and type as the failed anchor shall be tested unless otherwise directed by the UTILITY/Engineer. The testing agency shall verify that test loads will not overstress the embedded anchors.
  - a. Proof loads (tension only) shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at the specified load shall not exceed  $D/10$ , where D is the nominal anchor diameter.
  - b. Field testing and subsequent reports shall be performed in accordance with ASTM E488. Field testing shall be of tension capacity of the installed anchor only.

G. Special inspections for seismic resistance shall be performed as outlined in Section 1707 of the IBC.

END OF SECTION

SECTION 061000  
ROUGH CARPENTRY

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wood grounds, nailers, and blocking.
  - 2. Wood furring.
  - 3. Sheathing.

1.3 DEFINITIONS

- A. Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following products:
  - 1. Metal framing anchors.
  - 2. Construction adhesives.
- C. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:
  - 1. For each type of preservative treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
  - 2. For water-borne treated products, include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.
  - 3. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
  - 4. Warranty of chemical treatment manufacturer for each type of treatment.

1.5 DELIVERY, STORAGE, AND 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 materials.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

## PART 2 – PRODUCTS

### 2.1 LUMBER, GENERAL

- A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
  1. SPIB - Southern Pine Inspection Bureau.
  2. NLGA - National Lumber Grades Authority.
- D. Grade Stamps: Provide lumber with each piece factory-marked 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.
  1. For exposed lumber furnish pieces with grade stamps applied to ends or back of each piece; or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.
- E. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as 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 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

### 2.2 DIMENSION LUMBER

- A. For light framing (2 to 4 inches thick, 2 to 4 inches wide) provide the following grade and species:
  1. "Construction" grade.
  2. Southern Pine graded under SPIB rules.
  3. Spruce Pine Fir graded under NLGA rules.
- B. For structural light framing (2 to 4 inches thick, 2 to 4 inches wide), provide the following grade and species:
  1. "No. 2" grade or better.
  2. Same species as indicated on structural drawings.
- C. For structural framing (2 to 4 inches thick, 5 inches wide), provide the following grade and species:
  1. "No. 2" grade or better.
  2. Same species as indicated on structural drawings.

## 2.3 BOARDS

- A. Exposed Boards: Where boards will be exposed in the finished work, provide the following:
  - 1. Moisture Content: 19 percent maximum, "S-DRY" or KD-19.
  - 2. Where painted finish is indicated, provide "No. 1 Boards" per SPIB rules, "Select Merchantable Boards" per WCLIB rules, or "No. 2 Common Boards & Better" per WWPA rules.
- B. Concealed Boards: Where boards will be concealed by other work, provide lumber of 19 percent maximum moisture content (S-DRY or KD-19) and of following species and grade: Southern Pine No. 2 or Spruce Pine Fir No. 2.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 2 Boards" per SPIB rules.

## 2.5 CONSTRUCTION PANELS, GENERAL

- A. Construction Panel Standards: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood construction panels and, for products not manufactured under PS 1 provisions, with APA PRP-108.
- B. Trademark: Furnish construction panels that are each factory-marked with APA trademark evidencing compliance with grade requirements.

## 2.6 CONCEALED PERFORMANCE-RATED CONSTRUCTION PANELS

- A. General: Where construction panels are indicated for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.
- B. Wall Sheathing, Plywood, or OSB: APA RATED SHEATHING .
  - 1. Exposure Durability Classification: EXTERIOR.
  - 2. Exposure Durability Classification: EXPOSURE 1.
  - 3. Span Rating: As required to suit stud spacing indicated.

## 2.7 CONSTRUCTION PANELS FOR BACKING

- A. Plywood Backing Panels : For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade designation, APA C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 15/32 inch.

## 2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power Driven Fasteners: National Evaluation Report NER-272.
- D. Wood Screws: ANSI B18.6.1.
- E. Lag Bolts: ANSI B 18.2.1.
- F. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and where indicated, flat washers.

## 2.9 METAL FRAMING ANCHORS

- A. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
  - 1. Current Evaluation/Research Reports: Provide products for which model code evaluation/research reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with the building code in effect for this Project.
  - 2. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
- B. Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A525 for Coating Designation G60 and with ASTM A446, Grade A (structural quality); ASTM A526 (commercial quality); or ASTM A527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.
  - 1. Use galvanized steel framing anchors for rough carpentry exposed to weather, in ground contact, or in area of high relative humidity, and where indicated.

## 2.10 MISCELLANEOUS MATERIALS

- A. Sill Sealer Gaskets: Glass fiber resilient insulation fabricated in strip form for use as a 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.
- B. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturer.
- C. Water Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbonate (IPBC) as its active ingredient.

## 2.11 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

- A. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.
- C. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 3. Wood floor plates installed over concrete slabs directly in contact with earth.
- C. Pressure-treat wood members in contact with the ground or fresh water with water-borne preservatives to a minimum retention of 0.40 pcf.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless 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. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as 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. Install permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2 inches 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 FURRING

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.
  - 1. Firestop furred spaces on walls at each floor level and at ceiling line of top story, with wood blocking or noncombustible materials, accurately fitted to close furred spaces.
- B. Furring to Receive Plywood Paneling: Install 1 - inch by 3-inch furring at 2 feet o.c., horizontally and vertically. Select furring for freedom from knots capable of producing bent-over nails and resulting damage to paneling.
- C. Furring to Receive Gypsum Drywall: Install 1-inch by 2-inch furring at 16 inches o.c., vertically.
- D. Furring to Receive Plaster Lath: Install 1-inch by 2-inch furring at 16 inches o.c., vertically.
- E. Suspended Furring: Install suspended furring members of size and spacing indicated, including hangers and attachment devices. Level to a tolerance of 1/8 inch in 10 feet, except 1/4 inch in 10 feet for thick-coat plaster work.

### 3.4 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with N.F.P.A. "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Install framing members of size and spacing indicated.



- C. Anchor and nail as shown, and to comply with the following:
1. National Evaluation Report No. NER-272 for pneumatic or mechanical driven staples, P-Nails, and allied fasteners.
  2. Published requirements of manufacturer of metal framing anchors.
  3. "Recommended Nailing Schedule" of referenced framing standard and with N.F.P.A. "National Design Specifications for Wood Construction."
  4. "Table No. II - Recommended Nailing Schedule" of the Uniform Building Code.
  5. "Appendix C - Recommended Nailing Schedule" of the BOCA National Building Code.
  6. "Table 1705.1 - Fastening Schedule," of the Standard Building Code.

END OF SECTION



## SECTION 061001

### CARPENTRY

#### PART 1- GENERAL

##### 1.1 SUMMARY

- A. Carpentry work, and installation of items specified in other sections which are normally installed by the carpenters. In general, this work includes, but is not limited to, the following:
  - 1. Concealed framing, studs, furring, etc.
  - 2. Plywood roof and wall sheathing.
  - 3. Wood decking.
  - 4. Wood ceiling.
  - 5. Wood flooring.
  - 6. Braces, stripping, backing, blocking, cants, grounds, and nailers indicated or necessary to install roofing, cabinets, toilet room accessories, and to receive or back work of other trades.

##### 1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Painting refer to Section 099000 "Painting".

##### 1.3 QUALITY ASSURANCE

- A. Grading Marks: Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency identification; and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.
- B. Wood Preservative Treatment: Label each piece of pressure treated lumber with the Quality Control mark of the American Wood Preservers Bureau showing compliance with the appropriate standard.
- C. Fire Retardant Treatment: Label each piece of lumber and plywood with Quality Control mark of the American Wood Preservers Bureau showing compliance with the appropriate standard.

##### 1.4 PRODUCT HANDLING

- A. Keep carpentry materials dry during delivery, storage and handling. Store lumber in stacks for air circulation within stacks. Protect bottom of stacks against contact with damp surface. Protect exposed materials against weather. Do not store dressed or treated lumber or plywood outdoors.

## PART 2 - PRODUCTS

### 2.1 SOFTWOOD

- A. Comply with the standards of WCLIB "Standard Grading Rules for West Coast Lumber" for Douglas fir and SPIB "Standard Grading Rules for Southern Pine Lumber"; KD, S4S.
- B. For structural lumber 2" to 4" thick, 6" and wider, use KD, S4S, No. 2.
- C. For structural light framing, 2" to 4" thick, 2" to 4" wide, and studs, use KD, S4S, No. 2.
- D. For light framing 2" to 4" thick, 2" to 4" wide, use KD, S4S, Construction Grade.
- E. For finish lumber, use KD, S4S, vertical grain.
- F. Decking, use 2" X 6", KD, V-groove, Southern pine, No. 1 Dense.

### 2.2 SOFTWOOD PLYWOOD

- A. Comply with PS-1, Exposure 1 (exterior glue), Group 1, Southern pine or Douglas fir.
- B. Roof Sheathing: APA Rated Sheathing, Structural I, C-C or C-D Grade, span index 40/20; 3/4" thick.
- C. Wall Sheathing: APA Rated Sheathing, Structural I, C-C or C-D Grade, 3/4" thick. Where indicated, provide A-C at exposed unfinished wall.

### 2.3 CYPRESS

- A. Comply with standards of NHLA "National Hardwood Lumber Association". Use KD, Select, Bald Cypress. Note: Cypress to be preservative treated.

### 2.4 WOOD DECKING

- A. 2" X 6", T&G, V-groove.

### 2.5 WOOD CEILING

- A. 1" x 6", T&G, V-groove; clear fir or cypress.

### 2.6 WOOD FLOORING

- A. 1" X 6", T&G, V-groove.

### 2.7 ROUGH HARDWARE

- A. Nails, metal connectors, bolts, nuts, screws, washers, staples, and other fasteners (except as specified or noted otherwise); hot-dip galvanized steel.

### 2.8 WOOD PRESERVATIVE TREATMENTS

- A. Provide wood preservative treatments complying with the VOC Content limits calculated according to the South Coast Air Quality Management District (SCAQMD) Rule No. 1113, Architectural Coatings; LEED Credit EQ 4.2.

1. Below Ground: 350 g/L.
  2. Other: 350 g/L.
- B. Pressure Treatment by Pressure Process: Pressure treat above-ground items with alkaline copper quaternary (ACQ) preservative system, containing no arsenic or chromium; comply with AWPA C2 lumber and AWPA C9 plywood.
1. Above Ground: 0.25 lbs. retention/cu. ft.
  2. Ground Contact: 0.40 lbs. retention/cu. ft.
- C. Miter treatment, kiln dry lumber to maximum moisture content, of 19 percent. Do not use material that is warped or does not comply with the requirements for untreated material. Treat indicated items and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, air/vapor barriers and waterproofing.
  2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry and concrete.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPA M4.
- E. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

## 2.9 FIRE RETARDANT TREATMENT BY PRESSURE PROCESS

- A. Treat all lumber and plywood with fire retardant treatment process to comply with AWPA C20 and C27, respectively, for treatment type indicated.
1. Interior Type A: Hickson Corp. "Dricon", Hoover Treated Wood Products "Pyro-Guard", or Osmose "Flameproof LHC-HTT".
- B. Dry fire-retardant wood to moisture content of 19% or less for lumber and 15% or less for plywood before use.
- C. Identify "fire retardant treated wood" with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or other testing and inspecting agency acceptable to authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 INSTALLATION GENERAL

- A. Discard units of material with defects which might impair quality of work, and units which 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 as indicated and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.
- D. Use common wire nails, except as otherwise indicated or specified. 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; pre-drill as required.
- E. Anchor carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, strips, backing, and blocking, of thickness and shape required to secure work and equipment in place, as indicated on the drawings or required by conditions. Fasten wood grounds, furring and other engaging woodwork to various types of walls with approved types and sizes of nails, ties, and inserts, spaced to provide rigid secure supports.

### 3.2 ROOF SHEATHING

- A. 3/4" thick plywood. Install with face grain across supports; locate and stagger joints over supports. Fasten 6" o.c. at panel ends and 12" o.c. at intermediate supports with fasteners. Refer to structural notes.

### 3.3 WALL SHEATHING

- A. 3/4" thick plywood; install with face grain across supports; locate and stagger joints over supports. Fasten 6" o.c. at panel ends and 12" o.c. at intermediate supports with fasteners. Refer to structural notes.

### 3.4 WOOD DECKING

- A. 2" x 6" T&G fir or cypress. Install to wood structure as indicated.

### 3.5 WOOD CEILING

- A. 1" x 6" T&G Southern pine. Attach to wood blocking as indicated. Shim to provide plumb and level surface.

### 3.6 WOOD FLOORING

- A. 1" x 6" Red Oak. Install as indicated on drawings. Finish painting specified in Section 09 90 00.

### 3.7 ROUGH CARPENTRY

- A. Provide wood grounds, strips, bucks, plates, backing, and blocking, of thickness and shape required to secure work and equipment in place, as indicated on drawings or required by conditions. Fasten with approved types and sizes of nails, ties, and inserts, spaced to provide rigid secure supports.

### 3.8 ROUGH HARDWARE

- A. Provide rough hardware necessary or required for installation of work specified. Use sufficient size and number of spikes, nails, screws, bolts, etc., to insure rigidity, security, and permanence.

3.9 CLEAN-UP

- A. Remove from the premises all rubbish, debris, and unused materials which may be accumulated during the progress of the work.

END OF SECTION





## SECTION 06160

### ROOF SHEATHING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Roof sheathing.
  - 2. Sheathing joint-and-penetration treatment.
  - 3. Flexible flashing at openings in sheathing.
- B. Related Sections include the following:
  - 1. Division 6 Section 061000 Rough Carpentry

##### 1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
  - 3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
  - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
  - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
  - 6. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  - 1. Preservative-treated plywood.
  - 2. Fire-retardant-treated plywood.

## 1.2 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or GA-600, "Fire Resistance Design Manual".
- B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":
  - 1. Plywood.
  - 2. Fiberboard wall sheathing.

## 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: APA rated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

### 2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPAC9.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood, unless otherwise indicated.

### 2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Comply with performance requirements in AWPAC27.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Use Exterior type for exterior locations and where indicated.
  - 3. Use Interior Type A, High Temperature (HT) for roof sheathing and where indicated.

4. Use Interior Type A, unless otherwise indicated.
- B. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Identify fire-retardant-treated plywood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Application: Treat all plywood, unless otherwise indicated.

## 2.4 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior sheathing.
  1. Span Rating: Not less than 32/16.
  2. Nominal Thickness: Not less than 15/32 inch.

## 2.5 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

- A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Roofing Corporation.
    - b. Cornell Corporation.
    - c. Dow Chemical Company (The).
    - d. Johns Manville; Berkshire Hathaway Inc.
    - e. Rmax, Inc.
  3. Polyisocyanurate-Foam Thickness: 2 inch.
  4. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
- B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C 1289, Type II, Class 1, with oriented strand board adhered to spacers on one face.
- C. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V. Oriented-strand-board face has a second layer of oriented strand board adhered to it with spacers between.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atlas Roofing Corporation.
  - b. Cornell Corporation.
  - c. Dow Chemical Company (The).
  - d. Johns Manville; Berkshire Hathaway Inc.
  - e. Rmax, Inc.
3. Polyisocyanurate-Foam Thickness: 2 inch.
4. Oriented-Strand-Board Nominal Thickness: 7/16".
5. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 24 inches o.c.

## 2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  1. For roof sheathing, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  1. NES NER-272 for power-driven fasteners.
  2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
  - 1. Comply with "Code Plus" installation provisions in guide referenced in paragraph above.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Wall and Roof Sheathing:
    - a. Nail or staple to wood framing.
    - b. Screw to cold-formed metal framing.
    - c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION



## SECTION 061723

### SHOP FABRICATED WOOD TRUSSES

#### PART 1 – GENERAL

##### 1.1 SUMMARY

- A. Shop Fabricated or Prefabricated wood trusses, complete, including roof and girder trusses and truss accessories.

##### 1.2 SUBMITTALS

- A. Comply with Section 013300 "Submittal Procedures".
- B. Product Data: Submit fabricator's technical data covering lumber, metal plates, hardware, fabrication process, handling, and erection.
- C. Certificate: Submit certificate, signed by an officer of fabricating firm, indicating that trusses to be supplied for project comply with indicated requirements.
- D. Shop Drawings:
  - 1. Submit shop drawings showing species, sizes and stress grades of lumber to be used; pitch, span, camber, configuration and spacing for each type of truss required; type, size, material, finish, design value, and location of metal connector plates; and bearing and anchorage details.
  - 2. To the extent engineering design considerations are indicated as fabricator's responsibility, submit design analysis and test reports indicating loading, section modulus, assumed allowable stress, stress diagrams and calculations, and similar information needed for analysis and to ensure that trusses comply with requirements. Provide shop drawings which have been signed and stamped by a structural engineer licensed to practice in the state where trusses are installed.

##### 1.3 QUALITY ASSURANCE

- A. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:
  - 1. "Design Standard for Metal Plate Connected Wood Truss Construction".
  - 2. "Commentary and Recommendations for Handling, Installing, and Bracing Metal Plate Connected Wood Trusses".
  - 3. "Quality Standard for Metal Plate Connected Wood Trusses".
- B. Wood Structural Design Standard: Comply with applicable requirements of "National Design Specifications for Wood Construction" published by A.F.P.A.
- C. Design by Manufacturer: Trusses shall be designed by connector-plate manufacturer to support superimposed dead and live loads indicated, with design approved and certified by a structural engineer licensed to practice in jurisdiction where trusses will be installed.

- D. Connector Plate Manufacturer's Qualifications: Provide truss connector plates manufactured by a firm which is a member of TPI and which complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Standard for Metal Plate Connected Wood Trusses".
- E. Fabricator's Qualifications: Provide trusses by firm which has a record of successfully fabricating trusses similar to type indicated and which complies with following requirements for quality control:
  - 1. Fabricator participates in TPI "Quality Assurance Inspection Program" as a licensee authorized to apply TPI marks to trusses.
  - 2. Fabricator practices a quality control program which complies with, or is comparable to, one published in TPI "Quality Standard for Metal Plate Connected Wood Trusses" and which involves inspection by an independent inspection and testing agency acceptable to Architect and authorities having jurisdiction.
- F. Uniformity of Manufacture for Connector Plates: Provide metal connector plates from a single manufacturer.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Handle and store trusses with care, and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure.
- B. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

### PART 2 – PRODUCTS

2.1 MANUFACTURERS: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

- A. Metal Connector Plates:
  - 1. Alpine Engineered Products, Inc.
  - 2. Computrus, Inc.
  - 3. Mitek Ind.
  - 4. Robbins Mfg. Co.
  - 5. Tee-Lok Corp.
  - 6. Truswall Systems Corp.
- B. Metal Framing Anchors:
  - 1. Cleveland Steel Specialty Co.
  - 2. Harlen Metal Products, Inc.
  - 3. Silver Metal Products, Inc.
  - 4. Simpson Strong-Tie Company, Inc.
  - 5. Southeastern Metals Mfg. Co.
  - 6. United Steel Products Co.



## 2.2 MATERIALS

- A. Lumber:
1. Manufacturer lumber to comply with DOC PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review. NOTE: No. 3 lumber will not be allowed for tension members.
  2. Factory mark each piece of lumber with type, grade, mill, and grading agency.
- B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for dressed lumber, S4S. Provide seasoned lumber with a maximum moisture content of 19% at time of dressing. Do not alter the truss profiles without approval by Architect and Structural Engineer.
- C. Lumber Species: Southern pine graded by SPIB.
- D. Stress Rating: Provide lumber which has been graded or tested and certified, at indicated moisture content, to be in compliance with required stress ratings.
- E. Metal Connector Plates, Fasteners and Anchorages: No connector plates shall be smaller than 3" X 5".
1. Connector Plate Material: Fabricate from metal complying with following requirements:
    - a. Hot-Dip Galvanized Sheet Steel: Structural quality complying with ASTM A446, Grade A; zinc coated by hot-dip process to comply with ASTM A525, Designation G60; minimum coated metal thickness indicated, but not less than 0.036".
- F. Fasteners: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and fabrication.
1. Nails, Wire, Brads, Staples: FS FF-N-105.
  2. Power Driven Fasteners: National Evaluation Report NER-272.
  3. Wood Screws: ANSI B 18.6.1.
  4. Lag Bolts: ANSI B 18.2.1.
  5. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and where indicated, flat washers.
- G. Metal Framing Anchors:
1. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
    - a. Current Evaluation/Research Reports: Provide products for which reports exist from model code organization acceptable to authorities having jurisdiction that evidence compliance of metal framing anchors for application indicated within building code in effect for this project.

- b. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
- 2. Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A525 for coating designation G60 and with ASTM A446, "Grade A (structural quality); ASTM A526 (commercial quality); or ASTM A527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.
- 3. Truss Ties: 18 gage galvanized steel bent strap tie for fastening trusses. Types as indicated on drawings.

### 2.3 FABRICATION

- A. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with wood-to-wood bearing in assembled units.
- B. Fabricate metal connector plates to size, configuration, thickness and anchorage details required for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.
- D. Connect truss members by means of metal connector plates accurately located and securely fastened to wood members by means indicated or approved.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Erect and brace trusses to comply with recommendations of manufacturer and the Truss Plate Institute.
- B. Where trusses do not fit, return to fabricator and replace with trusses of correct size; do not alter trusses in field.
- C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacings indicated.
- D. Hoist units in place by means of lifting equipment suited to sizes and types of trusses required, applied at designated lift points as recommended by fabricator, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- E. Provide temporary bracing as required to maintain trusses plumb, parallel and in location indicated, until permanent bracing is installed.
- F. Anchor trusses securely at all bearing points to comply with methods and details indicated.

- G. Securely connect each truss ply required for forming girder trusses. Anchor trusses to girder trusses as indicated.
- H. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.
- I. Do not cut or remove truss members.

END OF SECTION



SECTION 072100  
BUILDING INSULATION

PART 1 - GENERAL

- 1.1 SUMMARY: Building insulation, complete, except as otherwise specified.
- 1.2 SUBMITTALS:
- A. Comply with Section 01300.
  - B. Submit manufacturer's installation instructions for each type of insulation. Include data substantiating that materials comply with physical and thermal properties, and other requirements of specified insulation.
- 1.3 PRODUCT HANDLING: Do not allow insulation materials to become wet or soiled. Comply with manufacturer's instructions for handling, storage, and protection during installation.
- 1.4 JOB CONDITIONS: Do not proceed with the installation of insulation until the work which follows (and which conceals the insulation) is scheduled to follow immediately.
- 1.5 QUALITY ASSURANCE:
- A. Concealed insulation shall have flamespread rating of not more than 75 and smoke developed rating not more than 450.
  - B. Exposed insulation shall have flamespread rating of not more than 25 and smoke developed rating not more than 450.
  - C. Foam Insulation: Edge or face of each piece of insulation shall bear label of an approved agency. Label shall contain manufacturer's or distributor's identification, model number, serial number or definitive information describing the products or materials performance characteristics and approved agency's identification.
- 1.6 COORDINATION: Coordinate work with work of other trades.

PART 2 - PRODUCTS

- 2.1 BATT INSULATION: 12" (R-38)(with moisture barrier towards attic side), as indicated, unfaced or foil faced fiberglass batts; OCF, Manville, Certainteed or equal. Provide other thicknesses as indicated on drawings.

## 2.2 MISCELLANEOUS MATERIALS:

- A. Provide adhesive for bonding insulation, mechanical fasteners, tapes, netting, and other items indicated and required for complete installation, as indicated and as recommended by the insulation manufacturer or as required by project conditions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION: Comply with manufacturer's instructions.

- A. Extend insulation full thickness over entire surface to be insulated. Cut and fit tightly around obstructions and fill voids with insulation.
- B. Securely install batt insulation in cavities, between studs, and elsewhere as indicated. Butt ends of batts closely together and fill all voids.
- C. Tape joints where required by project conditions.

END OF SECTION

## SECTION 073000

### ROOFING UNDERLAYMENT

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. This Section specifies a self-adhering sheet membrane used as underlayment for sloped roofs.
  - 1. Severe climate application, 180F resistance, Grace Ice & Water Shield.
- B. Related Sections: Refer to the following specification sections for coordination:
  - 1. Section 06100 - Rough Carpentry.
  - 2. Section 07240 – Composite Wall Panels
  - 3. Section 07600 – Flashing and Sheet Metal
- C. Referenced Standards: Comply with the requirements of the following standards published by ASTM International to the extent referenced in this section.
  - 1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers  
- Tension.
  - 2. ASTM D461 - Standard Test Methods for Felt.
  - 3. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
  - 4. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
  - 5. ASTM D3767 - Standard Practice for Rubber—Measurement of Dimensions.
  - 6. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
  - 7. ASTM G90 – EMMAqua test.

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.

##### 1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.
- B. Manufacturer: Minimum 10 years experience producing roofing underlayment.
- C. Installer: Minimum 2 years experience with installation of similar underlayment.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Protect from damage.
- B. Cover materials and store in dry condition between temperatures of 40 and 90 degrees F (5 and 32 degrees C). Use within one year of date of manufacture. Do not store at elevated temperatures as that will reduce the shelf life of the product.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURER

- A. Manufacturer: Grace Construction Products, 62 Whittemore Avenue, Cambridge, MA 02140, Toll Free 866-333-3726, [www.na.graceconstruction.com](http://www.na.graceconstruction.com).

#### 2.2 MATERIALS

- A. Self-Adhering Sheet Membrane Roof Underlayment: Provide Grace Ice and Water Shield by Grace Construction Products with the following characteristics:
  1. Material: Cold applied, self adhering membrane composed of a high strength polyethylene film coated on one side with a layer of rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the polyethylene.
  2. Color: Gray-black.
  3. Membrane Thickness: 40 mil (1.02 mm) ASTM D3767 procedure A (Section 9.1).
  4. Tensile Strength, Membrane: 250 psi (1720 kN/m<sup>2</sup>) ASTM D412 (Die C modified).
  5. Elongation, Membrane: 250% ASTM D412 (Die C modified).
  6. Low Temperature Flexibility: Unaffected @ -20°F (-29°C) ASTM D1970.
  7. Adhesion to Plywood: 3.0 lbs/in. width (525 N/m) ASTM D903.
  8. Permeance (Max): 0.05 Perms (2.9 ng/m<sup>2</sup>s Pa) ASTM E96.
  9. Material Weight Installed (Max): 0.3 lb/ft<sup>2</sup> (1.3 kg/m<sup>2</sup>) ASTM D461.
  10. Service Temperature: 180 degrees F (82.2 degrees C) per ASTM D1204
  11. Primer: Water-based Perm-A-Barrier WB Primer by Grace Construction Products.
  12. Code and Standards Compliance: Grace Ice and Water Shield meets the following:
    - a. Underwriters Laboratories Inc. Class A fire classification under fiber-glass shingles and Class C under organic felt shingles (per ASTM E108/UL 790).
    - b. Underwriters Laboratories Inc. Classified Sheathing Material Fire Resistance Classification with Roof Designs: P225, P227, P230, P237, P259, P508, P510, P512, P514, P701, P711, P717, P722, P723, P732, P734, P736, P742, P803, P814, P818, P824.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Prior to start of installation, inspect existing conditions to ensure surfaces are suitable for installation of roofing underlayment. Verify flashing has been installed. Starting work indicates



installers acceptance of existing conditions.

## 3.2 INSTALLATION

- A. Installation: Install roofing underlayment on sloped surfaces at locations indicated on the Drawings, but not less than at hips, ridges, eaves, valleys, sidewalls and chimneys, and surfaces over interior space within 36 inches (914 mm) from the inside face of the exterior wall. Strictly comply with manufacturer's installation instructions including but not limited to the following:
1. Schedule installation such that underlayment is covered by roofing within the published exposure limit of the underlayment.
  2. Do not install underlayment on wet or frozen substrates.
  3. Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.
  4. Remove dust, dirt, loose materials and protrusions from deck surface.
  5. Install membrane on clean, dry, continuous structural deck. Fill voids and damaged or unsupported areas prior to installation.
  6. Prime concrete and masonry surfaces using specified primer at a rate of 500-600 square feet per gallon (12-15 sqm/L). Priming is not required for other suitable clean and dry surfaces.
  7. Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Apply the membrane in valleys before the membrane is applied to the eaves. Following placement along the eaves, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.
  8. Side laps minimum 3-1/2 inches (89 mm) and end laps minimum 6 inches (152 mm) following lap lines marked on underlayment.
  9. Patch penetrations and damage using manufacturer's recommended methods.

## 3.02 CLEANING AND PROTECTION

- A. Protection: Protect from damage during construction operations and installation of roofing materials. Promptly repair any damaged or deteriorated surfaces.
- B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired in the opinion of the Architect.
- C. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protective film and reclean as necessary immediately before final acceptance.

END OF SECTION



## SECTION 07 4113 - METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Exposed fastener metal roof panels, with related metal trim and accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Division 05 Section "Structural Steel Framing" for structural steel framing supporting metal panels.
- B. Division 05 Section "Steel Decking" for continuous metal decking supporting metal panels.
- C. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal panels.
- D. Division 05 Section "Cold-Formed Metal Trusses" for cold-formed metal trusses supporting metal panels.
- E. Division 07 Section "Roof Insulation" for thermal insulation installed under metal panels.
- F. Division 07 Section "Air Barriers" for air barriers within roof assembly and adjacent to roof assembly.
- G. Division 07 Section "Metal Wall Panels" for factory-formed metal wall and soffit panels.
- H. Division 07 Section "Sheet Metal Flashing and Trim" for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.
- I. Division 07 Section "Manufactured Roof Specialties" for manufactured copings, reglets, and roof drainage items in addition to items specified in this Section.
- J. Division 07 Section "Joint Sealants" for field-applied Joint Sealants.
- K. Division 13 Section "Metal Building Systems" for steel framing supporting metal panels.

#### 1.3 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA): [www.aamanet.org](http://www.aamanet.org):
  - 1. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
  - 2. AAMA 809.2 - Voluntary Specification Non-Drying Sealants.
- B. American Society of Civil Engineers (ASCE): [www.asce.org/codes-standards](http://www.asce.org/codes-standards):
  - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM): [www.astm.org](http://www.astm.org):

1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
4. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
5. ASTM C 754 - Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
6. ASTM C 920 - Specification for Elastomeric Joint Sealants.
7. ASTM D 1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.
8. ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
9. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
10. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
11. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
12. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. FM Global (FM): [www.fmglobal.com](http://www.fmglobal.com):

1. ANSI/FM 4471 - Approval Standard for Class 1 Panel Roofs.

E. International Accreditation Service (IAS):

1. IAS AC 472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems, Part B.

F. Underwriters Laboratories, Inc. (UL): [www.ul.com](http://www.ul.com):

1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

#### 1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency and related trade contractors.

1. Coordinate building framing in relation to metal panel system.
2. Coordinate openings and penetrations of metal panel system.
3. Coordinate work of Division 07 Sections "Roof Specialties" and "Roof Accessories" and openings and penetrations and manufacturer's accessories with installation of metal panels.

#### 1.5 QUALITY ASSURANCE

A. Manufacturer/Source: Provide metal roof panel assembly and accessories from a single manufacturer providing fixed-base roll forming, and accredited under IAS AC 472 Part B.

B. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years experience in manufacture of similar products in successful use in similar applications.

- C. Installer Qualifications: Experienced Installer with minimum of five years experience with successfully completed projects of a similar nature and scope.
  - 1. Installer's Field Supervisor: Experienced mechanic, able to communicate with Owner, Architect, and installers, supervising work on site whenever work is underway.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets for specified products.
- B. details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, roof accessories, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work.
  - 1. Indicate points of supporting structure that must coordinate with metal panel system installation.
  - 2. Include data indicating compliance with performance requirements.
  - 3. Include structural data indicating compliance with requirements of authorities having jurisdiction.
- C. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
- D. Samples for Verification: Provide 12-inch- (305 mm-) long section of each metal panel profile. Provide color chip verifying color selection.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Indicating compliance of products with requirements, witnessed by a professional engineer.
- B. Qualification Information: For Installer firm and Installer's field supervisor.
- C. IAS Accreditation Certificate: Indicating that manufacturer is accredited under provisions of IAS AC 472.
- D. Manufacturer's Warranty: Sample copy of manufacturer's standard warranty.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Manufacturer's Warranty: Executed copy of manufacturer's standard warranty.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.
  - 1. Deliver, unload, store, and erect metal panel system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

2. Store in accordance with Manufacturer's written instructions. Provide wood collars for stacking and handling in the field.

#### 1.10 COORDINATION

- A. Coordinate sizes, profiles, and locations of roof curbs and other roof-mounted equipment and roof penetrations, based upon sizes of actual selected equipment.

#### 1.11 WARRANTY

- A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail within one year from date of Substantial Completion.
- B. Special Panel Finish Warranty: On Manufacturer's standard form, in which Manufacturer agrees to repair or replace metal panels that evidence deterioration of factory-applied finish within 10 years from date of Substantial Completion, including:
  1. Fluoropolymer Two-Coat System:
    - a. Color fading in excess of 10 Hunter units per ASTM D 2244.
    - b. Chalking in excess of No. 6 rating per ASTM D 4214.
    - c. Failure of adhesion, peeling, checking, or cracking.

#### 1.12 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
- B. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.
- C. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated:
  1. Wind Loads: latest edition of IBC
  2. Snow Loads: latest edition of IBC
  3. Deflection Limits: Withstand inward and outward wind-load design pressures in accordance with applicable building code with maximum deflection of 1/180 of the span with no evidence of failure.
  4. Seismic Performance: Comply with ASCE 7, Section 9, "Earthquake Loads.", and latest edition of IBC.
- D. Wind Uplift Resistance: Comply with UL 580 for wind-uplift class UL-90.
- E. FM Approvals Listing: Comply with FM Approvals 4471 as part of a panel roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 construction. Identify materials with FM Approvals markings.
  1. Fire/Windstorm Classification: Class 1A-90.
  2. Hail Resistance Rating: 1-SH.

- F. Air Infiltration: ASTM E 1680: Maximum 0.006 cfm/sq. ft. at 6.24 lbf/sq. ft static-air-pressure difference.
- G. Water Penetration: ASTM E 1646: No uncontrolled water penetration at a static pressure of 20 lbf/sq. ft..

#### 1.13 METAL PANEL MATERIALS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ50, prepainted by the coil-coating process per ASTM A 755/A 755M.

#### 1.14 METAL ROOF PANELS

- A. Large Tapered-Rib-Profile, Exposed Fastener Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with trapezoidal major ribs with intermediate stiffening ribs symmetrically placed between major ribs, installed by lapping edges of adjacent panels.
  - 1. Coverage Width: 36 inches
  - 2. Major Rib Spacing: 12 inches on center.
  - 3. Rib Height: 1-1/4 inch.
  - 4. Nominal Coated Thickness: 0.022 inch/26 gage
  - 5. Panel Surface: Smooth
  - 6. Exterior Finish: Fluoropolymer two-coat system
  - 7. Color: As selected by Engineer from manufacturer's standard colors

#### 1.15 METAL ROOF PANEL ACCESSORIES

- A. General: Provide complete metal roof panel assembly incorporating ridge, eave, rake, valley, and parapet trims, copings, fascias, gutters and downspouts, and miscellaneous flashings, in [manufacturer's standard profiles] [profiles as indicated]. Provide required fasteners, closure strips, support plates, and sealants as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.
- C. Panel Fasteners: Self-tapping screws and other acceptable fasteners recommended by roof panel manufacturer.
  - 1. Exposed Fasteners: Long life fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.
- D. Self-Adhering, High-Temperature Underlayment: Self-adhering, cold-applied sheet underlayment, minimum 30 mils (0.76 mm), recommended by metal panel manufacturer for application. Provide primer when recommended by underlayment manufacturer.
- E. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
  - 1. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.
  - 2. Concealed Joint Sealants: Non-curing butyl, AAMA 809.2.
  - 3. Exposed Joint Sealants: Urethane, single component, ASTM C 920.
- F. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 hot-dip galvanized zinc coating.

- G. Light Transmitting Panel: Manufacturer's standard UV-resistant translucent panel, formed to metal panel profile, white, with haze value of not less than 90 percent when measured per ASTM D 1003.
- H. Roof Accessories: Approved by metal roof panel manufacturer. Refer to Section 07 72 00 "Roof Accessories" for requirements for curbs, equipment supports, roof hatches, heat and smoke vents, ventilators, and preformed flashing sleeves.

#### 1.16 FABRICATION

- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Panel Lengths: Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings. Form from materials matching metal panel substrate and finish.

#### 1.17 FINISHES

- A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Fluoropolymer Two-Coat System: 0.2 – 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621, meeting solar reflectance index requirements.
- C. Interior Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.

### PART 2 - EXECUTION

#### 2.1 EXAMINATION

- A. Examine metal panel system substrate and supports with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panel installation.
  - 1. Inspect metal panel support substrate to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable supports at recommended spacing to match installation requirements of metal panels.
  - 2. Panel Support Tolerances: Confirm that panel supports are within tolerances acceptable to metal panel system manufacturer but not greater than the following:
    - a. 1/4 inch in 20 foot in any direction.
    - b. 3/8 inch over any single roof plane.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with metal roof panel system installation.



## 2.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, girts, furring, and other miscellaneous panel support members according to ASTM C 754 and manufacturer's written instructions.
- B. Flashings: Install flashings to cover exposed underlayment per Section 07 62 00 "Sheet Metal Flashing and Trim."

## 2.3 METAL PANEL INSTALLATION

- A. Exposed Fastener Metal Roof Panels: Install weathertight metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.
- B. Panel Sealants: Install manufacturer's recommended tape sealant at panel sidelaps and endlaps.
- C. Panel Fastening: Attach panels to supports using screws, fasteners, and sealants recommended by manufacturer and indicated on approved shop drawings.
  - 1. Fasten metal panels to supports at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.
  - 2. Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.
  - 3. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.

## 2.4 ACCESSORY INSTALLATION

- A. General: Install metal panel trim, flashing, and accessories using recommended fasteners and joint sealers, with positive anchorage to building, and with weather tight mounting. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
  - 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
  - 3. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.
- B. Joint Sealers: Install joint sealers where indicated and where required for weathertight performance of metal panel assemblies, in accordance with manufacturer's written instructions.
  - 1. Prepare joints and apply sealants per requirements of Division 07 Section "Joint Sealants."

2.5 CLEANING AND PROTECTION

- A. Remove temporary protective films immediately in accordance with metal roof panel manufacturer's instructions. Clean finished surfaces as recommended by metal roof panel manufacturer.
- B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

END OF SECTION

## SECTION 076000

### FLASHING AND SHEET METAL

#### PART 1 - GENERAL

- 1.1 SUMMARY: Sheet metal work, complete, except flashing and counter flashing in conjunction with modified bituminous sheet roofing.
- 1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS:
- A. Sealants; Section 07900.
- 1.3 SUBMITTALS: Comply with Section 01300.
- A. Product Data: Submit manufacturer's technical product data, installation instructions and general recommendations for each specified sheet material and fabricated product.
- B. Shop Drawings: Submit shop drawings for showing materials, gages, layout, profiles, methods of joining, and anchorage details for each sheet metal item.
- 1.4 JOB CONDITIONS: Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protection of materials and finishes.

#### PART 2 - PRODUCTS

- 2.1 MATERIALS:
- A. Sheet Metal:
1. Prepainted Steel Sheets: 24 gage hot dipped galvanized steel (G90) commercial quality, primed and finished one side with Kynar base fluoropolymer coating 1.0 mil total dry film thickness, and with washcoat on reverse side. Colors as selected by Architect from standard colors. Coat prepainted side with liquid applied factory installed strippable film for protection of finished surface. Vincent "ColorClad" or Peterson "PacClad".
  2. Aluminum Sheets: ASTM B 209, alloy 3003, temper #14, mill finish, 0.040" thick, mill finished.
  3. Lead: ASTM B 749, Type L51121, copper-bearing sheet lead, minimum 4 lb./sq. ft. except not less than 6 lb./sq. ft. for welding.
- B. Fasteners: Same metal as flashing/sheet metal or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with materials being fastened.

- C. Solder: ASTM B32, 50% tin and 50% lead, used with rosin flux.
- D. Roofing Cement: ASTM D 2822, asphaltic.
- E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- F. Bitumastic Coating: SSPC — Paint 12, cold applied solvent type bitumastic coating for application in dry film thickness of 15 mils per coat.
- G. Epoxy Seam Sealer: 2—part noncorrosive metal seam cementing compound, recommended by manufacturer for non—moving joints including riveted joints.
- H. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather—resistant seaming and adhesive application of flashing sheet.
- I. Paper Slip Sheet: 5-lb. rosin—sized building paper.
- J. Polyethylene Underlayment: 6 mil carbonated polyethylene film.
- K. Sealants: As specified in Section 07900.
- L. Metal Accessories: Sheet metal clips, cleats, clamping rings, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

## 2.2 FABRICATION:

- A. Fabricate counterflashing, flashing, and other sheet metal work not exposed to view of aluminum. Fabricate flashing, caps, trim, and other sheet metal work exposed to view of prepainted steel sheets. Use lead where indicated and where soft temper sheet is required to conform to roofing components.
- B. Fabricate work to comply with "SMACNA" Architectural Sheet Metal Manual", metal manufacturer' recommendations, and recognized industry practices.
- C. Fabricate for waterproof and weather—resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates.
- D. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.
- E. Fabricate prepainted steel with strippable film in place. If soldering is necessary, mechanically remove coating. Touch up with color matched paint.

- F. Seams: Fabricate nonmoving seams in sheet metal with flat—lock seams. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required. For metal other than aluminum, tin edges to be seamed, form seams and solder.
- G. Expansion Provisions: Where lapped or bayonet-type expansion provisions cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).
- H. Separate dissimilar metals from each other by painting each metal surface in area of contact with a heavy application of bitumastic coating, or by other permanent separation as recommended by manufacturers of dissimilar metals.

### PART 3 - EXECUTION

- 3.1 EXAMINATION: Examine substrates and conditions under which sheet metal work will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION:
  - A. SMACWA Details: Except as otherwise indicated or specified, comply with applicable recommendations and details of "Architectural Sheet Metal Manual" by SMACNA.
  - B. Manufacturer's Recommendations: Except as otherwise indicated or specified, comply with recommendations and instructions of manufacturer of sheet metal being installed.
  - C. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weatherproof.
  - D. Underlayment: Where aluminum is to be installed directly on cementitious or wood substrates, install a course of paper slip-sheet and a course of polyethylene underlayment.
  - E. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.
  - F. Seal edges of metal flashings to substrates with roofing cement; install bed or bead of cement in manner, which will maintain a watertight seal.

- G. Secure edges of flashing to other work with angles and bars, and seal with sealant as indicated.
  - H. Remove strippable film from prepainted work.
- 3.3 CLEAN—UP: After completion of work, clean roofing cement, sealant and bituminous paint from flashing, floors, and all surfaces so defaced. Remove all excess materials and scraps from the job and leave all surfaces neat and clean.

END OF SECTION

## SECTION 081100

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

###### A. Section Includes:

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

###### B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Flush Wood Doors".
3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
4. Division 08 Section "Door Hardware".
5. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

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

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

8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

### 1.3 SUBMITTALS

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

### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.



- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
  - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
  - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
  - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
    - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- E. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.
  - 1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM C1363 and meet or exceed the following requirements:
    - a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.29, R-Value 3.4, including insulated door, thermal-break frame and threshold.
  - 2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:
    - a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).
- F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

## 1.5 DELIVERY, STORAGE, AND HANDLING

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

## 1.6 PROJECT CONDITIONS

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

## 1.7 COORDINATION

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

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
  - 1. CECO Door Products (C).
  - 2. Curries Company (CU),
  - 3. or equal.

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

## 2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, and ANSI/SDI A250.4 for physical performance level.
  - 1. Design: Flush panel.
  - 2. Core Construction: Foamed in place polyurethane and steel reinforced core with no stiffener face welds.
    - a. Provide 18 gauge steel vertical reinforcements 6 inches apart and welded in place. Foamed in place polyurethane core is chemically bonded to all interior surfaces. No face welding is permitted.
    - b. Thermal properties to rate at a fully operable minimum U-Factor 0.374 and R-Value 2.53, including insulated door, Mercury thermal-break frame and threshold.
    - c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.378 and R-Value 2.5, including insulated door, kerf type frame, and threshold.
  - 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
  - 4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
  - 5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
  - 6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
  - 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
    - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
  2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
  3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
  4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
  5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Manufacturers Basis of Design:
1. Curries Company (CU) - Polystyrene Core - 707 Series.
  2. Curries Company (CU) - Energy Efficient - 797 Mercury Series.

## 2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.
- C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
  2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
  3. Manufacturers Basis of Design:
    - a. Curries Company (CU) – M Series.
    - b. Curries Company (CU) – Thermal Break TQ Series.
- D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:
  - a. Curries Company (CU) - C Series.
  - b. Curries Company (CU) - M Series.

- E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

## 2.6 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
1. Blade Type: Vision proof inverted V or inverted Y.
  2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
  2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

## 2.7 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

## 2.8 ACCESSORIES

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

## 2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
  - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
  - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
  - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire- performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
  - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
  - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - 1) Two anchors per jamb up to 60 inches high.
    - 2) Three anchors per jamb from 60 to 90 inches high.
    - 3) Four anchors per jamb from 90 to 120 inches high.
    - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
  - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - 1) Three anchors per jamb up to 60 inches high.
    - 2) Four anchors per jamb from 60 to 90 inches high.
    - 3) Five anchors per jamb from 90 to 96 inches high.
    - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
    - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
  11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

## 2.10 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
  - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
  - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
  - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

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

#### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 08110

SECTION 087100  
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
  2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
  2. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Division 08 Section "Door Hardware Schedule".
  2. Division 08 Section "Hollow Metal Doors and Frames".
  3. Division 08 Section "Flush Wood Doors".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  2. ICC/IBC - International Building Code.
  3. NFPA 70 - National Electrical Code.
  4. NFPA 80 - Fire Doors and Windows.
  5. NFPA 101 - Life Safety Code.
  6. NFPA 105 - Installation of Smoke Door Assemblies.
  7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
1. ANSI/BHMA Certified Product Standards - A156 Series
  2. UL10C – Positive Pressure Fire Tests of Door Assemblies

### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  - 3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

- G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives

of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### 1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with,

other warranties made by Contractor under requirements of the Contract Documents.

- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Twenty five years for manual surface door closer bodies.

## 1.8 MAINTENANCE SERVICE

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

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

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

## 2.2 HANGING DEVICES

### A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
  - a. Two Hinges: For doors with heights up to 60 inches.
  - b. Three Hinges: For doors with heights 61 to 90 inches.
  - c. Four Hinges: For doors with heights 91 to 120 inches.
  - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
  - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
  - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
  - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
  - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
  - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
5. Acceptable Manufacturers:
  - a. Bommer Industries (BO).
  - b. Hager Companies (HA).
  - c. McKinney Products (MK).

## 2.3 DOOR OPERATING TRIM

### A. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless



- otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
  4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
  5. Acceptable Manufacturers:
    - a. Rockwood Manufacturing (RO).
    - b. Trimco (TC).

## 2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
  1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
  2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: Manufacturer's Standard.
- D. Key Quantity: Provide the following minimum number of keys:
  1. Change Keys per Cylinder: Four (4)
  2. Master Keys (per Master Key Level/Group): Five (5).
  3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
  1. Acceptable Manufacturers:
    - a. Lund Equipment (LU).
    - b. MMF Industries (MM).
    - c. Telkee (TK).

## 2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
  2. Locks are to be non-handed and fully field reversible.
  3. Acceptable Manufacturers:
    - a. BEST Access Systems (BA) – 9K Cylindrical Series
    - b. Sargent Manufacturing (SA) – 10 Line.
    - c. Schlage (SC) – ND Series.
    - d. Yale Locks and Hardware (YA) 5400LN Series.
- B. Cylindrical Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
1. Locks are to be non-handed and fully field reversible.
  2. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) – CL3500 Series.
    - b. Falcon Lock (FA) - T Series.
    - c. Yale Locks and Hardware (YA) 4700LN Series.

## 2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Bored Locks and Latches: BHMA A156.2.
  3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
  4. Dustproof Strikes: BHMA A156.16.

## 2.7 HIGH HAZARD AREAS EXIT DEVICES (ONLY HIGH HAZARD AREAS)

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  6. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails and push rail assembly to be formed from high grade, non-ferrous, architectural steel materials. Provide heavy duty, one-piece chassis covers matching the material and finish of the mounting and push rails, and steel latchbolts incorporating a deadlocking feature. Exit devices and trims to be available in standard

architectural finishes.

1. Acceptable Manufacturers:
  - a. Dorma Products (DO) - 9000 Series.
  - b. Falcon Hardware (FA) - 24/25 Series.
  - c. Yale Locks and Hardware (YA) - 2100 Series.

## 2.8 DOOR CLOSERS

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

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.

B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Acceptable Manufacturers:
  - a. BEST Access Systems (BA) - HD7000 Series
  - b. Corbin Russwin Hardware (RU) - DC6000 Series.
  - c. Norton Door Controls (NO) - 8500 Series.
  - d. Sargent Manufacturing (SA) - 1431 Series.

- e. Yale Locks and Hardware (YA) - 3500 Series.
- C. Door Closers, Surface Mounted (Standard Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
- 1. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) - DC3000 Series.
    - b. LCN Closers (LC) - 1260-SLIM Series.
    - c. Sargent Manufacturing (SA) - 1331 Series.
    - d. Yale Locks and Hardware (YA) - 2700 Series.

## 2.9 ARCHITECTURAL TRIM

### A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
  - a. Stainless Steel: 300 grade, 050-inch thick.
- 4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
- 5. Acceptable Manufacturers:
  - a. Rockwood Manufacturing (RO).

## 2.10 DOOR STOPS AND HOLDERS

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

appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:
  - a. Rockwood Manufacturing (RO).

## 2.11 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
  1. National Guard Products (NG).
  2. Pemko Manufacturing (PE).
  3. Reese Enterprises, Inc. (RS).

## 2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.13 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware

finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

#### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

#### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

#### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

#### 3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.



### 3.8 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the owner with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Refer to drawings for hardware sets.

**END OF SECTION**



## SECTION 09 9100

### PAINTING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all painting complete as shown on the Drawings and as specified herein.
- B. It is the intent of this Section to paint all exposed structural and miscellaneous steel; tanks and systems; mechanical and electrical equipment; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. The pump station floor and valve vault floor shall be painted as scheduled, herein. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.
- C. The following items will not be painted:
  - 1. Concrete except where specified above and scheduled to be painted
  - 2. Stainless steel louvers, doors and frames.
  - 3. Finish hardware.
  - 5. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
  - 6. Factory pre-finished architectural components.
  - 7. Packing glands and other adjustable parts and name plates of mechanical equipment.
  - 8. Parts of buildings not exposed to sight, unless specifically noted otherwise.
  - 9. Maintenance equipment
  - 10. Plumbing fixtures.
  - 11. Mechanical, HVAC, Plumbing, Process, and Electrical equipment which has been finish painted in the factory.
  - 12. Stainless Steel or Aluminum hardware, ladders, stairs, rails, and equipment, unless specifically identified elsewhere.

##### 1.02 RELATED WORK

- A. Shop priming and surface preparation of equipment and piping are specified and included in the respective Section with the item to be primed.

##### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 3000.
- B. Product Data: For each type of product indicated.

- C. Samples: Submit the following for each type of coating system and in each color and gloss of finish coat indicated.
  - 1. Color cards for initial color selections.
  - 2. Three sets of 8-in by 8-in samples, on 1/4-in hardboard, of all colors required for all types of paint. Resubmit until approved.
- D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

#### 1.04 REFERENCE STANDARDS

- A. Steel Structures Painting Council (SSPC)
  - 1. SSPC SP-1 - Surface Preparation Specification No. 1 Solvent Cleaning.
  - 2. SSPC SP-2 - Surface Preparation Specification No. 2 Hand Tool Cleaning.
  - 3. SSPC-SP7 – Surface Preparation Specification No. 7 Brush-Off Blast Cleaning.
  - 4. SSPC-SP6 – Surface Preparation Specification No. 6 Commercial Blast Cleaning.
  - 5. SSPC-SP10 – Surface Preparation Specification No. 10 Near-White Blast Cleaning.
  - 6. SSPC-SP5 – Surface Preparation Specification No. 5 White-Metal Blast Cleaning.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.06 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

#### 1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Provide products by one of the following:
  - 1. Tnemec, Inc.(TN);
  - 2. The Sherwin Williams Company (SW)
  - 3. Induron Protective Coatings (ID)
  - 5. Or equal.

### 2.02 MATERIALS

- A. Material Compatibility:
  - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. Provide products of same manufacturer for each coat in a coating system.
- B. All painting materials shall be delivered to the work site in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.
- C. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used. Refer to Section 09901 for special primers.
- D. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.
- E. Colors: As selected by Engineer from manufacturer's full range.

### 2.03 COLOR CODING FOR PIPES AND EQUIPMENT

- A. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.
- B. All hanger saddles and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. Hanger rods and hanger rod connections to building structure shall be painted to match the color of the wall or ceiling to which it is attached.

### 2.04 TESTING EQUIPMENT

- A. Furnish to the Engineer for use on the Project for paint inspection, wet and dry film thickness gauges and all other equipment required by the Engineer for inspection.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
  - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a. Concrete: 12 percent.
    - b. Masonry (Clay and CMU): 12 percent.
    - c. Wood: 15 percent.
    - d. Gypsum Board: 12 percent.
  - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 4. Coating application indicates acceptance of surfaces and conditions.

### 3.02 PREPARATION

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and CMU surfaces to receive polyamide cured epoxy paint of all marks before application of finish.
- B. All metal welds, blisters, etc, shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.
- C. Concrete surfaces shall have been finished as specified in Section 033300. Report unsatisfactory surfaces to the Engineer. Concrete shall be left for one month minimum before painting and shall be free of dust, oil, curing compounds and other foreign matter.
- D. Concrete masonry unit surfaces shall be smooth and cleaned of all dust, loose mortar and other foreign matter.
- E. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.
- F. Galvanized, aluminum, and copper surfaces identified for coating shall have all oxidation and foreign material removed before painting by SSPC SP-1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP-2 standards to provide a uniform 1 mil surface profile.
- G. Existing Surfaces to be Repainted
  - 1. Existing concrete, masonry, steel and other previously field painted surfaces so noted or as provided in Paragraph 1.01B shall be repainted.

2. Preparation shall be in general as specified above for new surfaces except that all loose paint shall be removed and all edges of existing paint shall be feathered to ensure a smooth surface.
3. Paint removal, capture of its residue, and its disposal shall be handled in accordance with all laws and regulations concerning disposal of hazardous materials.
4. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface and environment the coating is being placed in. Perform adhesion and compatibility tests on existing substrates as ordered and required. Repainted areas shall be covered by the same guaranty specified for remainder of Project.

### 3.03 WORKMANSHIP

#### A. General

1. At the request of the Engineer, sample areas of the finished work prepared in strict accordance with this Section shall be furnished and all painting shall be equal in quality to the approved sample areas. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with factory or paint manufacturer's warehouse mixed colors shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.
2. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc, before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.
3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

#### B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the Contractor.
2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched

before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the Contractor.

3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the Engineer with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the Contractor.

#### C. Field Painting

1. All painting at the site shall be under the strict inspection of the Engineer. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.
3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the Engineer.
7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.
8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
9. Only the aluminum work noted on the Drawings or in the Painting Schedule shall be field painted.

#### 3.04 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
  1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.



2. Testing agency will perform tests for compliance with specified requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

### 3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.06 PAINTING SCHEDULE

- A. All colors will be selected by the Engineer.
- C. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat noted:
  1. Exterior non-submerged ferrous metals, including ductile iron pipe (exterior or in vaults).
    - a. First and Second Coat: On properly prepared unprimed metal or for touch-up
      - 1) TN: Series N69 (3.0-4.0 DFT)
      - 2) SW: Macropoxy 646 (3.0-4.0 DFT)
    - b. Third Coat:
      - 1) TN: Series 73 (3.0 DFT).
      - 2) SW: Acrolon Ultra (3.0 DFT)
  2. Interior non-submerged ferrous metals, including ductile iron pipe (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up.
    - a. First and Second Coats:
      - 1) TN: Series N69 (3.0-4.0 DFT)

- 2) SW: Macropoxy 646 (3.0-4.0 DFT)
- 3. Submerged ferrous metals and ferrous metals subject to submersion or splashing, including ductile iron pipe. Surface shall be lightly sanded or abraded before application of first field coat.
  - a. First Coat:
    - 1) TN: Series N69 (4.0 - 6.0 DFT)
    - 2) SW: Macropoxy 646 (4.0-6.0 DFT)
  - b. Finish Coat
    - 1) TN: Series 142 Epoxoline (12 – 16 DFT)
    - 2) SW: Sherplate PW (12-16 DFT)
- 4. UV exposed plastic piping and plastic components, or where scheduled
  - a. First and Second Coats:
    - 1) TN: Series 1026 (2.0 – 3.0 DFT)
    - 2) SW: Acrolon Ultra (2.0-3.0 DFT)
- 5. Galvanized surfaces where scheduled to be painted. (Mechanically abrade surfaces to a uniform profile of 1 to 2 mils and clean completely.)
  - a. First Coat:
    - 1) TN: N69/N69F (2.0 to 3.0 DFT)
    - 2) SW: Macropoxy 646 (2.0-3.0 DFT)
  - b. Second Coat:
    - 1) TN: Series 73 (2.5 to 3.5 DFT)
    - 2) SW: Acrolon Ultra (2.5 to 3.5 DFT)
- 6. New Exterior CMU
  - a. Waterproof according to Specification Section 071900
- 7. New Interior CMU
  - a. SW Preprite Block Filler at 7-8 mils DFT
  - b. SW Pro-Mar 200 Interior Latex Egg Shell at 1 mil DFT
  - c. SW Pro-Mar 200 Interior Latex Egg Shell at 1 mil DFT
- 8. New Exterior Wood Trim
  - a. SW Duration Exterior Acrylic Latex at 2.5 mils DFT
  - b. SW Duration Exterior Acrylic Latex at 2.5 mils DFT
- 9. New Interior Gypsum/ Wood
  - a. Joint Compound (for gypsum)

- b. SW Pro-Mar 200 Interior Latex Primer at 1 mil DFT
- c. SW Pro-Mar 200 Interior Latex Egg Shell at 1 mil DFT
- d. SW Pro-Mar 200 Interior Latex Egg Shell at 1 mil DFT

END OF SECTION



SECTION 13 34 00  
FABRICATED PRE-ENGINEERED PRECAST CONCRETE STRUCTURES

SECTION 1 – GENERAL

**1.1 WORK INCLUDED**

Contractor to furnish a precast concrete building to be field assembled by the manufacturer on the contractor's cast-in-place foundation or precast concrete floor panel as indicated on contract drawings and in accordance with manufacturer's recommendations. Precast building to be EASI-SET® brand Model 1216 as manufactured by a *LONESTAR PRESTRESS MANUFACTURING, INC.*. Building shall be provided by manufacturer with all necessary openings as specified by contractor in conformance with manufacturer's structural requirements.

**1.2 REFERENCES**

- A. ACI-318-11: Building Code Requirements for Structural Concrete and Commentary
- B. ASCE/SEI 7-10: Minimum Design Loads for Buildings and Other Structures
- C. IBC 2012: International Building Code
- D. PCI Design Handbook, 7th Edition
- E. Concrete Reinforcing Institute, Manual of Standard Practice
- F. UL-752 (Test Method level 5) for bullet resistance certified by a military approved laboratory.

**1.3 SYSTEM DESCRIPTION**

DESIGN REQUIREMENTS

**A. Building Dimensions:**

Exterior: 12' x 16' x 8'-4" (Excluding cast-in-place concrete floor slab)

Interior: 11'-4" x 15'-4" x 8'-0"

*Design case to be selected to correspond to the design criteria indicated in the aforementioned codes for the geographical location of the project or as specified.*

CASE 1: Typical

**B. Design Loads:**

1. Seismic Design Category 'C', Risk Design Category II
2. Roof Live Load (Snow) – 30 PSF
3. Floor Live Load – 150 PSF (if precast floor is provided)
4. Wind Loading\* – 115 MPH

\*Design loads relate to precast components only, not accessories (i.e. doors,

windows, vents, etc.)

- C. Roof: Roof panel shall have a peak in the center of 12-foot direction and shall slope  $\frac{1}{2}$ " to each side. The roof shall extend a minimum of 2  $\frac{1}{2}$ " beyond the wall panel on each side and have a turndown design which extends  $\frac{1}{2}$ " below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.
- D. Roof, floor, and wall panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners and along perimeter. Wall panels shall be set on top of floor panel.
- E. Floor panel or contractor supplied cast-in-place slab must have  $\frac{1}{2}$ " step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.

#### 1.4 SUBMITTALS

- A. Engineering calculations that are designed and sealed by a professional engineer, licensed to practice in the state where the project is located, shall be submitted for approval.
- B. Manufacturers' product literature shall be provided for any plumbing, electrical, and miscellaneous installed fixtures demonstrating compliance with these specifications.

#### 1.5 QUALITY ASSURANCE

- A. The precast concrete building producer shall be a plant-certified member of either the National Precast Concrete Association (NPCA), The Precast/Prestressed Concrete Institute (PCI), or equal.
- B. The precast concrete building producer shall demonstrate product knowledge and must have a minimum of 5 years experience manufacturing and setting precast concrete.
- C. The manufacturer must be a licensed producer of Easi-Set Buildings
- D. No alternate building designs to the pre-engineered EASI-SET® building will be allowed unless pre-approved by the owner 10 days prior to the bid date.

### SECTION 2 – PRODUCTS

#### 2.1 MATERIALS

- A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise specified.  
Welded Wire Fabric: ASTM 185, Grade 65
- C. Post-tensioning Strand: 41K Polystrand CP50,  $\frac{1}{2}$ " 270 KSI Seven-Wire strand, enclosed within a greased plastic sheath (ASTM A416). Roof and floor each shall be post-tensioned by a proprietary, second generation design using a single, continuous tendon. Said tendon is placed in the concrete slab to form a perimeter loop starting from one corner of the slab to a point where the cable entered the slab. The tendon then turns 90 degrees and follows the cable member(s) in the periphery to a point midway along the "X" axis of the concrete building panel and then turns 90 degrees along the "Y" axis of

the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel. This creates a cable pattern with no less than 2.5 parallel cables in any direction. To ensure a watertight design, no alternate methods shall be substituted for the post-tensioning.

- D. Sealant: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be DOW CORNING 790 silicone sealant or equal. Exterior caulk reveal to be 3/8"x 3/4" deep so that sides of the joint are parallel for proper caulk adhesion. Back of the joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.
- E. Vents: Two screened aluminum vents to be cast in rear wall. Vents shall be SUNVENT INDUSTRIES Model FL-164 or equal.
- F. Panel Connections: All panels shall be securely fastened together with 3/8" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 and hot dipped galvanized after fabrication. All fasteners to be 1/2" diameter bolts complying with ASTM A325 for carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior F-63 coil inserts, or equal. All inserts for corner connections must be secured directly to form before casting panels. No floating-in of connection inserts shall be allowed. Wall panels shall be connected to cast-in-place floor slab using expansion anchors providing adequate embedment by manufacturer.

## 2.2 ACCESSORIES

- A. Doors and Frames: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100) and as herein specified. All door and frame galvanizing shall be in accordance with ASTM A924 and A653, A60 minimum coating thickness.

- 1. The buildings shall be equipped with
  - i. double 3'-0" x 6'-8" x 1-3/4" thick insulated, 18 gauge, metal doors with 16-gauge frames (to meet wall thickness). Doors to have flush top cap. 12 gauge flat astragals shall be applied to the active leaf to protect against the elements or forced opening. Doors and frames shall be factory bonderized and painted with one coat of rust inhibitive primer and one finish coat of enamel paint; color to be BOLT BROWN unless specified otherwise.
  - ii. Single 3'0" x 6'-8" x 1-3/4" thick insulated, 18 gauge, metal door with 16-gauge frames (to meet wall thickness). Doors to have flush top cap. 12 gauge flat astragals shall be applied to the active leaf to protect against the elements or forced opening. Door and frame shall be factory bonderized and painted with one coat of rust inhibitive primer and one finish coat of enamel paint; color to be BOLT BROWN unless specified otherwise.
- 2. Doors and frames shall meet SDI standard Level 2, 1 3/4" heavy duty.  
Approved manufacturers: Republic, Steelcraft, Ceco, Black Mountain, Pioneer, Curries, Mesker, MPI, Door components or equal  
Approved distributor: Integrated Entry Systems

- B. Door Hardware:

1. Pull Handle: Shall meet requirements of ANSI A156.2. Shall be thru bolt attached and constructed of a minimum  $\frac{3}{4}$ " diameter stainless pull handle sized 8" center to center with a stainless backer plate, minimum 0.053" on both sides.

Approved manufacturers: Design Hardware, Don-Jo, or equal

2. Hinges: Shall comply with ANSI A156.1 and be of the ball bearing, non-removable pin type (3 per door minimum). Hinges shall be 4  $\frac{1}{2}$ " x 4  $\frac{1}{2}$ " US26D (652) brushed chrome finish. Manufacturer shall provide a lifetime limited warranty.

Approved manufacturers: Design Hardware, or equal

3. Deadbolt: Commercial Grade Deadbolt conforming to ANSI 156.5 furnished with a 2  $\frac{1}{4}$ " face plate and a 1" projecting deadbolt with hardened steel pins. Dead bolts shall be UL and ADA approved. Finish shall be US26D (626) brushed chrome finish. Manufacturer shall provide a lifetime limited warranty.

Approved manufacturers: Design Hardware, Dorma, or equal

4. Surface Bolt: 8" Surface bolt UL listed. Finish US26D (626) brushed chrome finish. (2 per inactive leaf)

Approved manufacturers: Don-Jo, Design Hardware, or equal

6. Threshold: Bumper Seal type threshold with a maximum 1" rise to prevent water intrusion. Thresholds shall be approved for UL 10B suitable for use with fire doors rated up to three hours.

Approved manufacturers: National Guard Products or equal

7. Overhead Door Holder: Heavy duty surface mounted hold open device with hold open/stop angle of 85 to 110 degrees. Construction shall be stainless steel. Finish US32D (630) satin stainless steel finish.

Approved manufacturers: ABH, Rockwood, or equal

8. Drip Cap: Aluminum drip cap with minimum projection of 2  $\frac{1}{2}$ " shall be furnished.

Approved Manufacturers: Design Hardware, National Guard Products, or equal

9. Door Stop: ANSI 156.16 approved wall mounted door stop with keeper constructed of a corrosion resistant cast brass material. Finish US26D (626) brushed chrome finish.

Approved manufacturers: Don-Jo, Rockwood, or equal

## 2.3 FINISHES

- A. Interior of Building: Smooth form finish on all interior panel surfaces unless exterior finish is produced using a form liner, then smooth hand-troweled finish.
- B. Exterior of Building: (Standard) Architectural precast concrete brick finish: Finish must be imprinted in top face of panel while in form using an open grid impression tool similar to EASI-BRICK®. Finished brick size shall be 2  $\frac{3}{8}$ " x 7  $\frac{5}{8}$ " with vertical steel float or light broom finish. Joints between each brick must be  $\frac{3}{8}$ " wide x  $\frac{3}{8}$ " deep. Back of joint shall be concave to simulate a hand-tooled joint. Each brick face shall be coated with the following water-based acrylic, water repellent penetrating concrete stain: 1) Canyon Tone stain by United Coatings, 2) Sherwin Williams (H&C concrete stain) or equal. Stain shall be applied per manufacturer's recommendation. Joints shall be kept substantially free of stain to maintain a gray concrete color. Stain color shall be BRICK RED unless specified otherwise.



## SECTION 3 – EXECUTION

### 3.1 SITE PREPARATION RECOMMENDATION (Field assembled on cast-in-place floor)

Work under this section relates to installation of the building by Easi-Set licensed producer on the customer's prepared foundation and site

- A.** Slab on grade (designed by others) to be minimum 6" thick and 4,000 psi steel reinforced concrete. Slab to be level within 1/8" in both directions and capable of supporting loads imposed by the structure. Floor slab must have a 7-1/2" x 1-1/2" step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.

### 3.3 SITE ACCESS

Contractor must provide a level, unobstructed area large enough for a crane and a tractor-trailer to park adjacent to the pad. Crane must be able to place outriggers within 5'-0" of edge of pad; truck and crane must be able to get side by side under their own power. No overhead lines may be within 75' radius of center of pad. Firm roadbed with turns that allow 65' lowbed tractor-trailer must be provided directly to site. No building shall be placed closer than 2'-0" to an existing structure unless specifically permitted.



SECTION 13 34 60  
FIBERGLASS EQUIPMENT SHELTER

- 1) REFERENCE SPECIFICATIONS, CODES, AND STANDARDS
  - a) ASTM D256 – Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
  - b) ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
  - c) ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - d) ASTM D2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
  - e) All references shall be of the latest revision.
  
- 2) SUBMITTALS
  - a) Units
    - i) All submittals, specifications, drawings, brochures, installation instructions, descriptive literature, etc. shall have all units of measurement in both Imperial and SI units.
  - b) Drawings
    - i) Project specific drawings, showing:
      - (1) Critical dimensions.
      - (2) Joints, connections, fasteners.
      - (3) Sizes, spacing, and locations of structural members, ribs, anchoring clips, and dimensional bracing.
      - (4) Materials and thicknesses of construction.
    - ii) Generic layouts or check marked brochures shall be rejected without review.
  - c) Specifications
    - i) Project specific specifications.
    - ii) Generic or check marked specifications shall be rejected without review.
  - d) Receiving, Handling, and Storage Instructions
  - e) Installation Instructions
  - f) Operation and Maintenance Instructions
  - g) Product Warranty
  - h) Test Data
    - i) Independent certified test results confirming material properties.
      - (1) Test results are to be performed on specimens representative of the resins and reinforcements submitted upon with such resins and reinforcements listed by the certifying party.
      - (2) Data shall be no more than three (3) years old.
  - i) Laminate Sample
    - i) 6-inch [15.24 cm] square sample of representative laminate, upon request.
  
- 3) RECEIVING, HANDLING, AND STORAGE
  - a) Receiving
    - i) Inspect for damage
      - (1) All parts should be inspected upon delivery to the site, noting any missing items or visible damage.
      - (2) Verify that surfaces have not been damaged or otherwise marked during transit.
      - (3) Base and panel connection flanges should also be inspected.
      - (4) For smaller boxed items make sure to verify that all packaging seals are in place and that there is no visible damage to the packaging.
    - ii) Investigate for order correctness and count
      - (1) Once the order has been received review the packing list against what has been received. Should any items not appear to be present or the configuration of the items does not match the description on the packing list, contact Openchannelflow immediately.
      - (2) Small connection hardware (nuts, bolts, etc.) not attached to the Equipment Shelter ship in individual boxes – with those contents clearly marked. Special care should be taken to secure these and any other small items that can be misplaced on a job site.

- b) Handling
  - i) While rugged and designed for a long service life, Equipment Shelters must be handled with care.
  - ii) When cranes, hoists, and other machinery are used to Equipment Shelters, spreader bars and lifting straps should always be used. When performing any overhead lift, all lifting eyes must be used in conjunction with good rigging practices. Rigging and lifting sequences and schedules of equipment are solely the responsibility of the installing party.
  - iii) Chains, ropes, and the like should never be used to move or position any Equipment Shelters as they may serrate the fiberglass laminate or compromise the protective gel coat surfaces.
  - iv) Lifting eyes are provided at each end (minimum) of Equipment Shelters and may be supplied along the length of the shelter as needed. All provided lifting eyes must be used to equalize the lifting loads.
- c) Storage
  - i) Equipment Shelters not intended for immediate installation may be stored until the site is ready for their installation.
  - ii) Equipment Shelters should only be stored in a location that is clean, level, and protected from construction traffic.
  - iii) When shipped on pallets, Equipment Shelters should be left on those pallets until such time as they are needed.

4) MANUFACTURER

- a) Supply Equipment Shelters as manufactured by Openchannelflow, 815 Branch Drive, Alpharetta, GA 30004 (phone: 855.481.1118 / fax: 855.3316475 / [www.openchannelflow.com](http://www.openchannelflow.com)).
- b) Shelter Works 2616 S. 3<sup>rd</sup> St., St. Louis, MO 63118-1918, (314) 664-9300, [www.shelterworks.com](http://www.shelterworks.com)

5) WARRANTY

- a) Equipment Shelters within the continental United States shall be warranted to be free of defects in workmanship and materials for five (5) years with a completed warranty registration.
- b) Equipment Shelters outside of the continental United States shall be warranted to be free of defects in workmanship and materials in accordance with the time frame agreed upon. Warranty work for such locations shall be performed at a location of Openchannelflow's choosing.
- c) The warranty period shall begin from the date of shipment.

6) SYSTEM DESCRIPTION

- a) Configuration
  - i) Size:
    - (1) Width:
      - (a) 10-feet 0-inches [3.05 m].
    - (2) Length:
      - (a) 10-feet 0-inches [3.05 m].
    - (3) Height (as measured at the highest point of the Shelter):
      - (a) 7-feet 6-inches [2.29 m].
  - b) Materials of Construction
    - i) Fiberglass reinforced plastic laminate
      - (1) ISO certified polyester laminating resin:
        - (a) Low VOC.
        - (b) Properties shall meet or exceed:
 

(i) Tensile Strength (ASTM D638)	12,000 psi [82.74 MPa].
(ii) Flexural Strength (ASTM D790)	23,000 psi [158.6 MPa].
(iii) Flexural Modulus (ASTM D790)	800,000 psi [5.516 GPa].
(iv) Barcol Hardness (ASTM D2583)	30.
(v) Notched Izod (ASTM D256)	8 ft-lb/in [4.272 J/cm].
(vi) Temperature limit	150° F [65.56° C].
      - (2) E-glass:
        - (a) Minimum of 30% of laminate content by weight.
        - (b) Silane coupling agent.

- (c) C-glass shall not be allowed.
- ii) Gel coat:
  - (1) All surfaces must be gel coated.
  - (2) 15 mil cured thickness.
  - (3) U.V. inhibitors in all gel coat formulations, regardless of application or installation location.
  - (4) Color:
    - (a) Interior surfaces: Arctic White.
    - (b) Exterior surfaces: Arctic White.
- iii) Insulating core:
  - (1) Rigid, unfaced, CFC / HCFC free, closed cell polyisocyanurate
    - (a) Properties shall meet or exceed:
 

(i) Density (ASTM D1622)	2.0 lb/ft <sup>3</sup> [32 kg/m <sup>3</sup> ]
(ii) Initial R-value (ASTM C518)	6.0 Hr ft <sup>2</sup> F/Btu [1.06 m <sup>2</sup> C/W]
(iii) Compressive Strength (ASTM D1621)	27 psi [186 kPa]
(iv) Shear Strength (ASTM C273)	22 psi [151 kPa]
(v) Tensile Strength (ASTM 1623)	41 psi [283 kPa]
(vi) Surface Burn (E84)	
1. Flame spread	<25
2. Smoke developed	<185

c) Design

- i) ASCE 7-05
  - (1) Category I
  - (2) Wind
    - (a) Speed 100 mph [144.8 kph], basic 3-second
    - (b) Iv 1.15
    - (c) Exposure C
  - (3) Snow
    - (a) Live Load 30 psf [2.155 kPa]
- ii) IBC
  - (1) Construction Type III
  - (2) Occupational group U

d) Construction

- i) Molded construction utilizing X-Web technology.
- ii) Laminate Schedule:
  - (1) Exterior gel coat:
    - (a) 15 mils cured.
  - (2) Outer laminate:
    - (a) 1/8-inch [0.3175 cm] thick.
  - (3) Insulating core:
    - (a) 2-inch [5.08 cm] thick.
  - (4) Inner laminate:
    - (a) 1/8-inch [0.3175 cm] thick.
  - (5) Inner gel coat:
    - (a) 15 mil cured.

7) COMPONENTS

a) Doors

- i) Quantity
  - (1) 2 - 8068 double doors
- ii) Handedness
  - (1) Outswing.
  - (2) Left handed (LH) (outward opening, hinged on left).
  - (3) Right handed (RH) (outward opening, hinged on right).
- iii) Door thickness shall be 1 3/4-inches [4.445 cm]
  - (1) Dimensional thickness tolerance shall not exceed +/- 3/32-inch [0.2381 cm].
- iv) Overhead door closer

- (1) Norton 1703BCHCOV 689.
  - (2) Hold open action.
  - (3) ANSI A156.4 Grade 2 for 1,000,000 cycles.
  - v) Doors shall be mounted with T-304 stainless steel surface mounted strap hinges.
    - (1) The use of continuous piano hinges or other fastening methods shall not be allowed.
  - vi) EDPM edge-grip door seals shall be applied along the full perimeter of the door opening.
    - (1) Edge-grip trim shall be chemically bonded to door opening.
  - vii) Hardware
    - (1) Knob lockset
      - (a) Schalge A70PD PLY 630.
      - (b) Stainless steel construction.
      - (c) Exterior keylocking (classroom style) – no alternate.
      - (d) Schlage C style keys - keyed alike with key code indicated on load center panel schedule.
    - (2) Two-point stainless steel door hardware
      - (a) Exterior lever handle.
      - (b) Interior shall be provided with a door override and cushioned handle.
      - (c) Staple for user-supplied padlock.
    - (3) Panic hardware
      - (a) Stainless steel construction.
      - (b) Exterior key locked ball knob.
      - (c) Interior push bar.
  - viii) Integral door threshold 1/2-inch [1.27 cm] high.
  - ix) Doors shall meet NEMA 3R for watertightness.
  - b) Lifting
    - i) Eyes
      - (1) Minimum of (2) removable lifting eyes
        - (a) 3,400 lb [1,542 kg] vertical load limit / eye (minimum).
        - (b) Construction
          - (i) Hot dipped galvanized steel.
          - (ii) T-304 stainless steel.
          - (iii) T-316 stainless steel.
        - (c) Installation
          - (i) Factory installed and silicone sealed (flatbed shipment).
          - (ii) Shipped loose for field installation with plugs and silicone sealant for openings.
  - c) Mounting Flange
    - i) Each end and center panel sections shall be provided with an integrally molded base-mounting flange.
      - (1) 3-inches [7.62 cm] wide
        - (a) Measured from the interior laminate surface to the end of the flange.
      - (2) 1/4-inch [0.635 cm] thick.
      - (3) Pre-drilled every 12 to 15-inches [30.48 to 38.1 cm] on center for 1/2-inch [1.27 cm] diameter x 4 1/2-inch [11.43 cm] long T-304 wedge style stainless steel anchor bolts (by others).
      - (4) Neoprene / EPDM / SRB weather-resistant, adhesive backed gasket.
- 8) EQUIPMENT
- a) Electrical
    - i) Conduit
      - (1) PVC, schedule 40.
      - (2) PVC, schedule 80.
      - (3) PVC coated galvanized steel.
      - (4) Galvanized steel.
    - ii) Load Center
      - (a) Plug-in style breakers.
      - (b) Style
        - (i) \_\_\_\_\_ A main lug, convertible.
        - (ii) \_\_\_\_\_ A main circuit breaker (MCB).

- (c) NEMA
    - (i) 1 metallic.
    - (ii) 3R metallic.
  - (d) Phase
    - (i) Single phase.
    - (ii) Three phase.
  - (e) Square D QO11224L125GC.
  - (f) *Specialty*
    - (i) 125 A main lug.
    - (ii) 8 space.
    - (iii) NEMA 3R thermoplastic
    - (iv) Single phase.
    - (v) GE TPL412R.
- iii) Outlet
  - (1) Interior.
  - (2) 20 A GFCI.
  - (3) Commercial grade duplex.
  - (4) Clear weather cover.
  - (5) Leviton N7899-GY.
- iv) Switch
  - (1) Exterior.
  - (2) Duplex.
    - (a) Independent control of interior lights and fan.
  - (3) Leviton CS120-2GY.
- v) Wiring
  - (1) Stranded 12 gauge THHN.
- b) HVAC
  - i) Fan
    - (1) 585 CFM [0.46 CMM].
    - (2) Exhaust.
    - (3) Fiberglass hood with fixed fiberglass insect screen.
    - (4) Dayton 1HLA1.
  - ii) Heater
    - (1) 1,500 watt.
    - (2) Shallow wall mount frame.
    - (3) Line powered.
    - (4) Integral thermostat.
    - (5) Dayton 5ZK68 with 5ZK72 frame.
  - iii) Shutter
    - (1) 10-inch x 10-inch [25.4 cm x 25.4 cm].
    - (2) Intake.
    - (3) Fiberglass hood with fixed fiberglass insect screen.
    - (4) Dayton 5C210.
- c) Lighting
  - i) Control
    - (1) Exterior duplex switch box.
      - (a) Independent control of interior light and fan.
    - (2) Leviton CSB1-20W.
  - ii) Fixture
    - (1) Lithonia XWL232-MVOLT.
    - (2) Utilizes (2) T-8, 32 watt lamps.
    - (3) Instant start, multi-volt (120-277 VAC, 60 Hz) ballast.
    - (4) Dust resistant, wet location, IP65.
- d) Mounting
  - i) (2) 48-inch [121.9 cm] L slotted fiberglass mounting struts (for use with user-supplied mounting panel).

## 9) EXECUTION

### a) Examination

- i) Verify that the Equipment Shelter dimensions are correct and that the site conditions are suitable for installing the unit.
- ii) Equipment Shelters must remain sealed between the section joints. Where required, apply one or two continuous beads of silicone on all exterior section joints before proceeding with the installation.

### b) Installation

#### i) Concrete Foundation Slab

- (1) Provide a concrete foundation slab on which to mount / secure the Equipment Shelter. The slab should extend a minimum of 6-inches [15.24 cm] on all sides beyond the Equipment Shelter and the base mounting flange (if external).
- (2) The thickness of the slab should be a minimum of 6-inches [15.24 cm], but as local soil conditions may vary, the final design of the slab and anchoring details are the responsibility of the installing party and must be sized so as to prevent wind uplift and any other applicable local conditions.
- (3) The slab must have a smooth, troweled surface to provide uniform support over the entire base structure. The slab must be level in both directions to within 1/8-inch [0.3175 cm] and free from exposed aggregate and debris.

#### ii) Lifting the Equipment Shelter

- (1) Inspect all of the lifting lugs to verify that they are tightly secured to the Shelter sections.
- (2) Inspect the installation location and surrounding areas for any obstacles (INCLUDING OVERHEAD) that may cause difficulties or present a hazard – addressing them as necessary before proceeding.**
- (3) On the concrete foundation slab caulk out the corners of the intended location of the Equipment Shelter, making sure the installation is square.
- (4) Using **ALL** of the provided lifting lugs and **PROPER RIGGING TECHNIQUES**, move the Equipment Shelter to the desired installation location.
- (5) If the installation location is suitable and the installation square, lift the Equipment Shelter so that the provided base mounting flange sealant can be applied.
- (6) Apply the sealant and then lower the Equipment Shelter onto the slab.

#### iii) Securing the Equipment Shelter

- (1) With all doors shut, drill the concrete foundation slab at each pre-drilled base mounting flange location to the size / depth as indicated by the anchor bolt manufacturer.
- (2) During initial setting of the Equipment Shelter, anchor bolt locations may be skipped to minimize the time needed to square the Equipment Shelter on the slab.
- (3) Verify the operation of the door(s).
- (4) Once the Equipment Shelter has been squared on the slab, the initial anchor bolts should be securely tightened.
- (5) With the initial anchor bolts secured, the remaining anchor bolts should be installed and secured.
- (6) Verify the operation of the door(s).
- (7) All anchor bolt locations should be used to ensure that wind uplift cannot occur.

### c) Adjust and Clean

- i) Verify that the complete installation meets the criteria above and any additional criteria supplied by the Engineer.
- ii) Clean the flow surfaces in accordance with the manufacturer's operation and maintenance instructions.
- iii) Remove all trash and debris, leaving the site in a clean condition.



## SECTION 22 1209

### PRESSURE GAUGES & TRANSMITTERS

#### PART 1 - GENERAL

##### 1.1 GENERAL

- A. Contractor shall furnish and install pressure gauges as shown on the Drawings and as specified herein.

##### 1.2 SUBMITTALS

- A. In accordance with Section 013300 "Submittal Procedures".
- B. Submit the following Product Data for approval, as a minimum include the following:
  - 1. Materials of construction and statement of suitability for application.
  - 2. Pressure Range and Dial Size(s). Indicate location of pressure gauge and dial size at each installation point.
  - 3. Manufacturer's Operation, Maintenance, Installation, Storage, and Handling recommendations, as applicable. Submit in accordance with Section 017823 "Operation and Maintenance Data".
  - 4. Warranty.
    - a. Submit in accordance with Section 017823 "Operation and Maintenance Data" and with Section 017836 "Warranties and Bonds", as applicable.

#### PART 2 - PRODUCTS

##### 2.1 PRESSURE GAUGES

- A. AMETEK, U.S. Gauge Division, Series 1550 gauges, or approved equal. Features shall be as follows:
  - 1. Mounting: Stem.
  - 2. Solid back, stainless steel case with stainless steel crimped ring.
  - 3. Window: Polycarbonate, sealed to case with a polychloroprene gasket.
  - 4. Dial: White aluminum with black markings.
  - 5. Pointer: Black aluminum.
  - 6. Movement: Brass.
  - 7. Bourbon Tube: Phosphor bronze.
  - 8. Socket Connection: Brass.
  - 9. Liquid Fill: Glycerin.
  - 10. Connection Size: 1/4" NPT.
  - 11. Dial Size: 2-1/2" or as indicated on the Drawings.
  - 12. Pressure Range: 0-25 psi

##### 2.2 ACCESSORIES

- A. Liquid-filled gauges shall be furnished factory-filled, with gauge guards. Gauge guards shall be of PVC construction, with PTFE diaphragms.
- B. All gauges shall be furnished with a ball type gauge cock.
- C. All gauges shall be furnished with a brass pressure snubber.

- D. Isolation valve shall be lever type SS304 ball valves threaded to match assembly.
- E. Gauges shall be isolated from the flow stream using an all welded diaphragm seal with a flushing connection.
  - 1. Size ½"
  - 2. Material: 316LSS
  - 3. Filling Fluid: Glycerin
  - 4. Manufacturer: Ashcroft Type 312
- F. The Pressure Gauge shall be assembled at a certified vendor to assemble the diaphragm and pressure gauge and shipped to the project site as one unit.
- G. Components unless otherwise specified shall be SS 304

### 2.3 PRESSURE TRANSMITTERS

- A. Pressure transmitters shall be Rosemount (Emerson) 2088 Absolute and Gauge Pressure Transmitters (0-200 psi). Transmitters shall be mounted on a Rosemount 306 inline manifold with ¼" NPTF pressure connections. The 4-20 mA shall be integrated with the RTU for SCADA feed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install gauges as shown on the Drawings and as recommended by the manufacturer.

END OF SECTION

## SECTION 260000

### ELECTRICAL - GENERAL PROVISIONS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required and install complete and make operational, electrical system as shown on the Drawings and as specified herein.
- B. The work shall include the following:
  - 1. Coordinate the electrical service requirements with the power company and provide the electrical service(s) from the Power Company at the locations indicated.
  - 2. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under Divisions 1, 11, 13 and 15.
  - 3. Provide conduit, wiring and terminations for variable frequency drives, reactors, harmonic filters, transformers and power factor correction capacitors furnished and mounted under other related Divisions.
- C. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work under this sub-bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the buildings and structures and noted the locations and conditions under which the work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work.

##### 1.02 SUBMITTALS

- A. As a minimum all equipment specified in each Section of Division 16 shall be submitted at one time. As an example all lighting fixtures shall be submitted together, all motor control centers shall be submitted together, etc. Submittals that do not comply will be returned disapproved.
- B. Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude parts not applicable to the project. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submittal piece of literature and each submittal drawing shall clearly reference the Project Specification and/or Contract Drawing that the submittal is to cover. General catalogs will not be accepted as cut sheets to fulfill submittal requirements.
- C. Check shop drawings for accuracy prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to this Section and the Drawings. This statement shall also list all exceptions to this Section and the Drawings. Mark submittals to identify proposed equipment including accessories, options and features being

proposed for approval and exclude parts not to be used. Shop drawings not so checked and noted shall be returned marked NOT APPROVED.

- D. The Engineer's check shall be for conformance with the design concept of the project and compliance with this Section and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by this Section and the Drawings.
- E. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
- F. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."
- G. Operation and Maintenance Data
  - 1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists including replacement part numbers, to instruct operating and maintenance personnel unfamiliar with such equipment.
  - 2. Manuals shall include the following as a minimum:
    - a. A complete "As-Built" set of approved shop drawings.
    - b. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
    - c. Detailed service, maintenance and operation instructions for each item supplied.
- H. Exceptions for Submittals
  - 1. Exceptions to the Specifications or Drawings shall be clearly defined by the Electrical Subcontractor in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the Specifications shall be at the sole discretion of the Engineer.
- I. Submittals will be returned to the Contractor under one of the following codes.

Code 1 -"APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 -"APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the

equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 -"APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may, at his own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 10 calendar days of the date of the Engineer's transmittal requiring the confirmation.

Code 4 -"APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

Code 5 -"NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 -"COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Code 7 -"RECEIPT ACKNOWLEDGED" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval; and, is being filed for informational purposes only. This code is generally used in acknowledging receipt of *means and methods of construction* work plan, field conformance test reports, and Health and Safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

### 1.03 REFERENCE STANDARDS

- A. Electric equipment, materials and installation shall comply with the National Electrical Code (NEC).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

### 1.04 PRIORITY OF THE CONTRACT DOCUMENTS

- A. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

- B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.
- C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.
- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.
- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times

#### 1.05 ENCLOSURE TYPES

- A. Unless otherwise required, electrical enclosures shall be NEMA Types as follows:
  - 1. NEMA 4 in outdoor locations, rooms below grade including basements and buried vaults and "WET" locations shown on the Drawings.
  - 2. NEMA 4X in "CORROSIVE" locations shown on the Drawings.

#### 1.06 SERVICE AND METERING

- A. Service will be obtained as shown on the drawings.
- B. The Contractor shall be responsible for the following work:
  - 1. Obtain an estimate from the power company for the work described above and include the cost of the power company work in the Bid Price.
  - 2. Make all arrangements with the power company for obtaining electrical service, pay all power company charges.

#### 1.07 CODES, INSPECTION AND FEES

- A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.
- B. Obtain all necessary permits and pay all fees required for permits and inspections.

#### 1.08 INTERPRETATION OF DRAWINGS

- A. Unless specifically stated to the contrary, the Drawings do not show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.
- B. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.
- C. Conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed. Unless otherwise indicated install branch circuit conduits exposed in process/ industrial type spaces and concealed in finished spaces.
- D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation. Where home-runs indicate conduit is to be installed concealed or exposed the entire branch circuit shall be installed in the same manner.
- E. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- F. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials to install and place in satisfactory operation all power, lighting and other electrical systems shown.
- H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.
- I. Raceways and conductors for low voltage (120 Volts) thermostats controlling HVAC unit heaters, exhaust fans and similar equipment are not shown on the Drawings. Provide raceways and conductors between the thermostats, the HVAC equipment and the motor starters for a complete and operating system. Raceways shall be installed concealed in all finished space and may be installed concealed or exposed in process spaces. Refer to the HVAC drawings for the locations of the thermostats.

#### 1.09 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which electrical equipment furnished under Division 16 must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

#### 1.10 RECORD DRAWINGS

- A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings."

#### 1.11 MATERIALS AND EQUIPMENT

- A. Materials and equipment furnished under this contract shall be new.
- B. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

#### 1.12 EQUIPMENT IDENTIFICATION

- A. Identify equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 16 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.
- B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.
- C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

### PART 2 PRODUCTS (NOT USED)

### PART 3 EXECUTION

#### 3.01 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all slots for electrical work and form before concrete is poured.
- B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

#### 3.02 CUTTING AND PATCHING

- A. Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete as specified. Saw cut concrete and masonry prior to breaking out sections.



### 3.03 INSTALLATION

- A. Work not installed according to the Drawings and Specification shall be subject to change as directed by the Engineer at Contractor's expense.
- B. Electrical equipment shall be protected against mechanical and water damage. Store all electrical equipment in dry permanent shelters. Do not install electrical equipment in place until structures are weather-tight.
- C. Damaged equipment shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion and at the Contractor's expense.
- D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer.

### 3.04 WORK SUPERVISION

- A. The Contractor shall designate in writing the qualified electrical supervisor who shall provide supervision to all electrical work on this project. The minimum qualifications for the electrical supervisor shall be a master electrician as defined by the Arkansas Board of Electrical Examiners. The supervisor or his appointed alternate possessing at least a journeyman electrician license shall be on site whenever electrical work is being performed. The qualifications of the electrical supervisor shall be subject to approval of the Owner and the Engineer.
- B. All master and journeyman electricians shall be licensed in accordance with Arkansas Code Title 17 Chapter 28 - Electricians. The website located at <http://www.arkleg.state.ar.us> publishes the text of this statutory requirement. No unlicensed electrical workers shall perform work on this project. Apprentice electricians in a ratio of not more than one apprentice per journeyman electrician will be allowed if the apprentices are licensed and actively participating in an apprenticeship program recognized and approved by the Arkansas Board of Electrical Examiners.

END OF SECTION



## SECTION 261100

### RACEWAYS, BOXES, FITTINGS AND SUPPORTS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.
- B. Home runs indicated are to assist the contractor in identifying raceways to be installed concealed or exposed. Raceways identified to be installed exposed on the Drawings shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

#### PART 2 PRODUCTS

##### 2.01 RACEWAYS AND FITTINGS

- A. Steel Conduit and Fittings
  - 1. Rigid metal conduit (GRS), couplings, factory elbows and fittings shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading and shall comply with ANSI C 80.1 and UL/6.
  - 2. Intermediate metal conduit (IMC), couplings, factory elbows and fittings shall be medium wall steel tubing with a hot-dipped galvanized finish inside and out after threading and shall comply with UL/1242.
  - 3. Electrical metallic tubing (EMT), factory elbows and fittings shall be thin wall steel tubing with an electrically galvanized finish after fabrication and comply with ANSI C80.3 and UL/797.
  - 4. Acceptable manufacturers:
    - a. Allied Tube & Conduit Corp.
    - b. LTV Steel Tubular Products Corp.
    - c. Triangular PWC Inc.
    - d. Or equal.
  - 5. Rigid metal and intermediate metal conduit fittings shall be of the threaded type, and shall be steel or malleable iron, with a hot-dipped galvanized finish. Threadless fittings and split couplings are not allowed except in specific applications as approved by the Engineer.

6. Electrical metallic tubing fittings shall be of the rain tight, concrete tight, compression type with malleable iron or pressure cast steel body, steel hex type compression nut and electrically galvanized finish.
7. Acceptable manufacturers:
  - a. Appleton Electric Co.
  - b. O-Z Gedney Co.
  - c. RACO Inc.
  - d. Gould/Efcor
  - e. Steel City
  - f. Or equal

B. PVC Coated Rigid Steel Conduit and Fittings

1. PVC coated rigid steel conduit shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading with a minimum 0.040-in thick, polyvinyl chloride coating permanently bonded to it and an internal chemically cured urethane or enamel coating. The rigid steel conduit shall comply with ANSI C80.1 and UL/6 prior to coating.
2. PVC coated couplings, factory elbows and fitting shall be furnished with a PVC coating bonded to steel the same thickness as used on the PVC coated conduit. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap.
3. Acceptable manufacturers:
  - a. "OCAL" as manufactured by Thomas & Betts
  - b. "Plasti-Bond Red" as manufactured by Robroy Industries
  - c. Triangle PWC Inc
  - d. Or equal

C. Non Metallic Conduit and Fittings

1. PVC conduit shall be rigid polyvinyl chloride schedule 40. Rigid PVC conduit up to trade sizes 3-1/2-in shall comply with NEMA TC-2 and UL/651 and shall be sunlight resistant, rated for use with 90 degree C conductors in exposed, direct burial or concrete encased applications. Underground utility duct, 4-in trade size and above, shall be polyvinyl chloride (PVC).
2. Connectors, couplings, fittings and ancillary materials shall be supplied by the conduit manufacturer. Connectors, fittings and ancillary materials shall be rated for the environment for which they are installed.

3. Acceptable manufacturers:
  - a. Carlon Corp.
  - b. Certained Corp.
  - c. Conux Pipe Systems, Inc.
  - d. Or equal.

D. Liquid-tight Flexible Metal Conduit, Couplings and Fittings

1. Liquid-tight flexible metal conduit shall be square locked, galvanized steel flexible conduit with a moisture proof, flame resistant, polyvinyl chloride jacket, for use with rigid metal conduit systems. Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal.
2. Liquid-tight conduit fittings shall be hot-dipped mechanically galvanized, positive grounding, screw in type. Provide external bonding lugs on sizes 1-1/4-in and larger. Box connectors shall have insulated throats as manufactured by the Thomas & Betts Co.; Crouse-Hinds Co. or equal.
3. Acceptable Manufacturers:
  - a. American Flexible Conduit Co.
  - b. Anaconda Metal Hose/ANAMET Inc.
  - c. Electri-flex Co.
  - d. Thomas & Betts
  - e. O-Z Gedney
  - f. Or equal

2.02 BOXES AND FITTINGS

A. Dry and Damp Location Boxes and Fittings

1. Outlet boxes shall be zinc-galvanized, extra depth, pressed steel with knockouts and of size and type suitable for the intended application.
2. Boxes that are less than 100 cubic inches in size used for junction or pull boxes shall be zinc galvanized pressed steel not less than 14 USS gauge with appropriate blank covers, minimum size 4-11/16-in square by 2-1/8-in deep.
3. Boxes that are 100 cubic inches and larger shall be constructed of hot dip galvanized sheet steel without knockouts. Covers shall be secured with round head brass machine screws. All joints shall be welded and ground smooth.

4. Terminal cabinets shall be NEMA 12 sheet steel unless otherwise shown on the Drawings. Boxes shall be painted and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Terminal boxes shall be furnished with latching hinged doors, terminal mounting straps and brackets. Terminal blocks shall be rated not less than 20A, 600V.
5. Acceptable Manufacturers:
  - a. Appleton
  - b. Raco
  - c. Steel City
  - d. Hoffman
  - e. Electromate Division of Robroy Ind.
  - f. Wiegmann

B. Wet Location Boxes and Fittings

1. NEMA 4 terminal boxes, junction boxes, pull boxes, etc, shall be sheet Type 316 stainless steel unless otherwise shown on the Drawings. Boxes shall have continuously welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel clamps. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt.
2. Cast or malleable iron device boxes shall be Type FD. Boxes and fittings shall have cadmium-zinc finish with cast covers and stainless steel screws.
3. Cast aluminum device boxes shall be Type FD. Boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws
4. Acceptable Manufacturers:
  - a. Appleton
  - b. Crouse-Hinds
  - c. Steel City
  - d. Hoffman
  - e. Electromate - Division of Robroy Ind.
  - f. Or equal

## 2.03 HARDWARE

### A. Conduit Mounting Equipment

1. Stainless steel channel with stainless steel hardware shall be used in ALL indoor areas and in outdoor locations.
2. Furnish any and all necessary supports, brackets, conduit sleeves, racks and bracing as required. All boxes and hardware shall be stainless steel.

### B. Conduit Supports

1. Trapezes
  - a. In dry indoor areas, beams, channels, struts, hangers, bracing, rods, beam clamps, accessories and components shall be stainless steel.
  - b. Stainless steel beams, channels, struts or fiberglass beams, channels, struts with stainless steel hangers, bracing, rods, beam clamps, accessories and components shall be used in all areas.
2. Conduit Racks
  - a. In dry indoor areas, conduit racks, accessories and components shall be stainless steel.
  - b. Stainless steel conduit racks with stainless, accessories and components shall be used in all areas.

## PART 3 EXECUTION

### 3.01 RACEWAY APPLICATIONS

- A. Refer to Table 16110-1 for specific raceway application requirements.
- B. All conduit of a given type shall be the product of one manufacturer.

### 3.02 BOX APPLICATIONS

- A. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed.
- B. All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-in and larger.

**TABLE 16110-1**  
**Raceway Application Guidelines**

<b>Location/Circuit Type</b>	<b>Raceway Type</b>
<p><u>All locations</u></p> <ul style="list-style-type: none"> <li>▪ Class 2 and 3 signal wiring and 4-20 mA instrumentation cables, non-fiber (copper) data highway.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Exposed - Galvanized rigid steel (GRS) conduit. Use PVC coated rigid steel conduit in corrosive areas.</li> <li>▪ Concealed - Galvanized rigid steel (GRS) conduit.</li> <li>▪ Underground - PVC duct (as specified) in duct bank.</li> <li>▪ Use PVC coated steel conduit for single conduit direct burial applications.</li> </ul>
<p><u>Clean, dry non-finished areas</u> - electrical rooms, generator rooms, mechanical rooms, shops, dry storage, etc.</p>	<ul style="list-style-type: none"> <li>▪ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Galvanized rigid steel (GRS).</li> <li>▪ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.</li> </ul>
<p><u>Process areas</u> - non-corrosive, non-hazardous locations designated as DAMP or WET on the Drawings.</p>	<ul style="list-style-type: none"> <li>▪ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Galvanized rigid steel (GRS).</li> <li>▪ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.</li> </ul>
<p><u>Outdoor areas</u> - all locations.</p>	<ul style="list-style-type: none"> <li>▪ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Galvanized rigid steel (GRS). PVC conduit shall not be used exposed.</li> <li>▪ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete structures.</li> </ul>

### 3.03 FITTINGS APPLICATIONS

- A. Combination expansion-deflection fittings shall be used where exposed conduits cross structure expansion joints or in straight runs where expansion is anticipated. Combination expansion-deflection fittings shall be installed where embedded conduits cross structural expansion joints. Refer to Structural Drawings for expansion joint locations. Provide bonding jumpers around fittings.



- B. All underground conduit penetrations at walls or other structures shall be sealed watertight. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions and the details shown on the Drawings.
- C. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.
- D. Insulated throat grounding bushings shall be used where specified herein and where conduits stub up into electrical equipment such as MCC's, switchgear, etc.

### 3.04 INSTALLATION

- A. No conduit smaller than 3/4-in electrical trade size shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required by the NEC after every 270 degrees of bends and for straight run not to exceed 200 feet or as directed.
- B. All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc, shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits. The ends of all conduits shall be temporarily plugged to exclude dust, moisture and debris from entering during construction.
- C. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.
- D. Conduits noted as spare shall be capped or plugged at both ends with easily removable fittings.
- E. Conduit terminating in NEMA 3R, 4, 4X enclosures shall be terminated with Myers type conduit hubs.
- F. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.
- G. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings.
- H. Conduits shall be installed using threaded fittings except for PVC or EMT.
- I. The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used.
- J. All conduits entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer's designated area, directly below the vertical section in which the conductors are to be terminated. The 3-in extension of conduit above the floor slab or concrete equipment pad may be reduced to a dimension that suits the equipment manufacturer's installation requirements if the 3-in stub-up interferes with the equipment being provided.
- K. Rigid galvanized steel conduits buried in earth shall be completely painted with bitumastic.
- L. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.

- M. PVC coated rigid galvanized steel conduit shall be used for elbows at risers at the utility pole for electrical and telephone service conduits. Rigid galvanized steel conduit shall be used at utility pole for electrical and telephone service and fire alarm conduits to a height of 10-ft above finished grade. Furnish and install weather heads at service pole riser if required by utility company.
- N. Liquid-tight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present or may require removal. Non-metallic flexible conduit can be used with rigid PVC conduit systems.
- O. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.
- P. PVC coated rigid steel conduit shall be used as a transition section where concrete embedded conduit stubs out of floor slabs or through below grade walls or where conduit installed under building slabs on grade stub out of floors. The PVC coated rigid steel conduit shall extend a minimum of 3-in into and out of the floor slab, concrete pad, or wall to allow for proper threading of the conduit.
- Q. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as recommended by manufacturer.
- R. Conduit supports, other than for underground raceways, shall be spaced at intervals not exceeding the distance required by the NEC to obtain rigid construction.
- S. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.
- T. Conduit Supports (Other than Underground Raceways)
  - 1. Trapezes
    - a. Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.
    - b. Lateral seismic restraints (Sway Bracing) shall be spaced 30-ft or less.
    - c. Horizontal seismic restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.
    - d. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.
    - e. Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.

2. Flush Mounted Supports
  - a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
  - b. Attachment to concrete shall be with cast-in-place inserts, cast-in place welded plates with welded studs or stainless adhesive anchors.
3. Conduit Racks
  - a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
  - b. Horizontal seismic restraints shall be spaced at 30-ft or less, with welded studs or stainless adhesive anchors.
4. Conduit Hangers
  - a. Conduit hangers shall be vertical supported 10-ft or less, as required to obtain rigid conduit construction.
  - b. Lateral seismic restraints (Sway Bracing) shall be spaced 20-ft or less.
  - c. Horizontal seismic restraints shall be spaced at 30-ft or less. There shall be at least one horizontal restraint per horizontal run.
  - d. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.
  - e. Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.
5. All reinforcing bars shall be located by the Electrical Subcontractor with the use of a rebar locator prior to installing adhesive capsule type anchors. Mark the location of all reinforcing bars in an area bounded by a line drawn at least 18-in from the edge of the support bearing/weld plates on all four sides of the bearing/weld plates prior to fabricating and installing bearing/weld plates.
6. Where interference occurs, adjust anchor locations to clear reinforcing bars and alter support configuration at no additional cost to the Authority.
- U. Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed. Channel supports shall be ground smooth and fitted with plastic end caps.
- V. Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc, for a rigid installation. Channel supports shall be ground smooth and fitted with plastic end caps.
- W. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment. Conduit noted as spare shall be capped or plugged at both ends with easily removable fittings

- X. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314. Enclosure type and material shall be as specified herein.
- Y. Pull or junction boxes shall be furnished and installed where shown on the Drawings, in every 200 feet of straight conduit runs or in runs where more than the equivalent of four 90 degree bends occur or at any point necessary for wire pulling and splicing. Splices shall not be made in pulling elbows.

END OF SECTION

## SECTION 261200

### WIRES AND CABLES (600 VOLT MAXIMUM)

#### PART 1 GENERAL

##### 1.01. SCOPE OF WORK

- A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

##### 1.02. DELIVERY, STORAGE AND HANDLING

- A. Carefully handle all conductors to avoid kinks and damage to insulation.

#### PART 2 PRODUCTS

##### 2.01. GENERAL

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.
- B. All conductors shall be stranded, except that lighting and receptacle wiring may be solid.
- C. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.
- D. Wire shall have 600 Volt insulation except where indicated otherwise.

##### 2.02. BUILDING WIRE

- A. Wire for lighting, receptacles and other circuits not exceeding 150 Volts to ground shall be NEC type THHN/THWN as manufactured by General Cable.; American Insulated Wire Corp.; Southwire Co.; or equal.
- B. Wire for circuits over 150 Volts to ground within buildings and structures shall be NEC type THHN/THWN as manufactured by General Cable.; American Insulated Wire Corp.; Southwire Co.; or equal.
- C. Wire for circuits over 150 Volts to ground used underground or for service entrance shall be NEC type THHN/THWN as manufactured by General Cable.; American Insulated Wire Corp.; Southwire Co.; or equal.
- D. Bare copper ground wire shall be stranded, annealed copper wire ASTM-B3 alloy coated soft copper electrical wire ASTM B189.
- E. Equipment grounding conductors shall be NEC Type THW green and sized in accordance with NEC Table 250-122. Ground grid conductors shall be insulated unless shown otherwise on the Drawings.

2.03. CONTROL, STATUS AND ALARM WIRE

- A. Wire shall be No.14 AWG NEC type THHN/THWN stranded as manufactured by The Okonite Co.; General Cable.; American Insulated Wire Corp.; Southwire Co.; or equal.

2.04. INSTRUMENTATION WIRE

- A. Wire for process instrumentation signals (i.e. 1-5 VDC, 4-20 mADC), R.T.D., potentiometer and similar signals shall be:
  - 1. Single pair cable:
    - a. Conductors: 2 No. 16 stranded and twisted on 2-in lay
    - b. Insulation: XLP with 600 Volt, 105 degrees C rating
    - c. Shield: 100% Aluminum/polyester foil with drain wire
    - d. Jacket: PVC with UL Subject 13, UL 1581 and manufacturers' identification
    - e. Max overall diameter: 0.262-in
    - f. Miscellaneous: UL Listed as Instrument Tray Cable for use in accordance with Article 727 and Article 725 of the NEC.
    - g. Manufacturers: Belden; Manhattan; General Cable; The Okonite Co.; or equal
  - 2. Area Network (LAN) Ethernet cable shall be designed for use with a high-speed (100 Mbps/Gbps) Ethernet communications network. The twisted pair cable shall have nominal impedance of 100 ohms at 1 Mhz and a maximum attenuation of 10 dB per 1000 feet at 1 Mhz. The twisted pair cable shall be plenum rated and shall have a minimum of four 24 AWG solid copper conductor pairs. All RJ-45 terminations on the twisted pair cable shall be done as specified by the manufacturer. Terminations shall provide strain relief on the cable jacket. Strain relief on the wire and /or wire insulation shall not be acceptable. Cable and connections shall meet or exceed Category 5 ratings and upon completion of the network installation, the system shall be tested to Category 5 standards. Category 5 cable shall be as manufactured by Belden; Phoenix; Digital; Seicor, or equal.

2.05. SPLICES (POWER CONDUCTORS)

- A. Unless otherwise indicated on the Drawings, splices shall not be made in the cables without prior written approval of the Engineer. Where splicing is approved by the Engineer, splicing materials for all 600 Volt splices shall be made with long barrel, tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.
- B. Wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking

spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co.; Burndy; Amp; or equal.

- C. Compression type connectors shall be insulated with a heat shrink boot or outer covering and epoxy filling. Splice kits shall be as manufactured by Raychem (Tyco); Ideal Industries; 3M Co. or equal.
- D. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Innovation; Ideal Industries, Inc., or equal.

#### 2.06. MOTOR CONNECTIONS

- A. Motor connections shall be ring type mechanical compression terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and springwasher. Connections shall be insulated with a Raychem Type RVC, roll-on stub insulator; Thomas & Betts, Shrink-Kon MSCV20; or equal. For wire sizes N0. 8 and larger, long barrel, tin plated copper compression (hydraulically pressed) type connections Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp., or equal).

#### 2.07. TERMINATION AND SPLICES (CONTROL, STATUS AND ALARM CONDUCTORS)

- A. Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.
- B. Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.
- C. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Innovation; Ideal Industries, Inc or equal.

#### 2.08. TERMINATIONS (INSTRUMENTATION CABLES)

- A. Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

#### 2.09. WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be "Omni-Grip" as manufactured by the W.H. Brady Co.; Thomas & Betts Co., SMS; 3M Co., STD-TAG; or equal.
- B. Wire and cables with diameters exceeding the capacity of the "Omni-Grip" shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp.; 3M Co.; or equal.

#### 2.10. PATCH PANELS (Fiber Optic)

- A. Patch panels shall be suitable for wall mounting, comprised of internal mounting plate, slack cable take up/organizer blocks, patch block with connectors and grounding lugs as indicated or required. Panels shall be NEMA 12 construction unless otherwise indicated on the Drawings. Patch panels shall be suitable for multimode system operation at 800 and 1300 nanometers.
- B. Patch panels shall be as manufactured by Siecor Corp., Hickory, NC; 3M Telecom Systems Group, Austin, TX; AT&T Network Systems, Norcross, GA; or equal.

2.11. SPLICE CLOSURES (Fiber Optic)

- A. Splice closures shall be constructed of thermoplastic, suitable for “butt” or “through” cable entry, moisture tight sealing arrangement, removable splice tray organizer, splice trays for mechanical splices, suitable for multimode system operation at 800 and 1300 nanometers, grounding lugs or equivalent for grounding cable armor.
- B. Splice closures shall be as manufactured by Siecor Corp., Hickory, NC; 3M Telecom Systems Group, Austin, TX; AT&T Network Systems, Norcross, GA; or equal.

2.12. TERMINAL Connectors (Fiber Optic)

- A. Terminal connectors shall be Type ST2 compatible design with ceramic ferrule and strain relief boot. The epoxy used to attach connectors to the individual fibers shall be a heat cure type featuring an accelerated cure cycle and color change upon cure completion. Connector specifications shall be as follows:
  - 1. Insertion loss (typical): 0.5 dB
  - 2. Durability (mating cycles): 1000 (minimum)
  - 3. Repeatability: Less than 0.2 dB
  - 4. Operating Temperature: minus 40 to plus 80 degrees C

PART 3 EXECUTION

3.01. INSTALLATION

- A. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end and in all manholes, hand holes and pull boxes with wire and cable markers.
- B. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.
- C. Provide multi-conductor control and signal cables within the underground system. Cables shall be installed continuous from building to building without splices. Individual control conductors and twisted shielded pairs signal cables will not be allowed in underground systems.
- D. The crimping tools used in securing the conductor in the compression type connectors or terminal lugs shall be those made for that purpose and for the conductor sizes involved. The crimping tool shall be the ratchet type which prevents the tool from opening until the crimp



action is completed. Such tools shall be a product of the connector manufacturer.

- E. Install an equipment grounding conductor in all raceways.
- F. Seal openings in slabs and walls through which wires and cables pass.
- G. Pull cables from the direction that requires the least tension. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer's recommended minimum bending radius. Use a dynamometer and constant velocity power puller. Velocity should not be less than 15-ft./min. or more than 50-ft./min. Do not exceed the cable manufacturer's maximum recommended tension.
- H. If cable can not be terminated immediately after installation, install heat shrinkable end caps.
- I. Fireproof exposed cables in manholes, vaults, pullboxes, switchgear and other areas not protected by conduit where medium voltage cables are present. Use fire-proofing tape and glass tape in accordance with the manufacturer's instructions. Fire-proofing tape shall be installed with one half-lapped layer of Scotch Brand 77 Electric Arc and Fireproofing Tape (3M Corp., or equal). Tape shall be secured with a two-layer band of Scotch Brand 69 Glass Electrical Tape (3M Corp., or equal) over the last wrap.
- J. Fiber Optic Cables
  - 1. Provide all material, equipment and labor to install the fiber optic cables indicated and as specified herein.
  - 2. Installation shall be in accordance with the NEC.
  - 3. Install cables in the raceway systems as indicated. Inspect raceways prior to pulling in the cables. Notify the Engineer of any conditions which would prevent installation of the specified cables before proceeding with the installation.
  - 4. Lubricate cables with lubricants specially formulated for fiber cabling jackets during installation. Do not exceed cable manufacturers' specifications for tensile strength and bending radius. Pulleys used to aid in the installation of the fiber optic cable must be sized according to the minimum bending radius. The pulling tension of all fiber cables during installation shall be recorded using a strip recorder. The printout of the strip recorder shall be submitted to the Engineer.
  - 5. For fiber optic cable systems provided under Division 16, provide breakout kits, splice closures, signal transceivers, power supplies, patch panels, pigtailed and jumpers to install a complete data highway communications network. Patch panels and splice enclosures shall be wall mounted.
  - 6. Splices shall be made in designated enclosures above ground only. Provide adequate put-up lengths on cable reels to make termination-to-termination runs without splices. Where splices are indicated, provide mechanical splices with attenuation losses of 0.3 dB or less. Make splices watertight and provide mechanical protection equal to the cable jacket.
  - 7. Support cables in riser conduits at intervals as required by the NEC.

8. Installation tools and materials shall be approved by the cable manufacturer.
9. The polishing process of terminal connectors shall be a two stage wet process using 3.0 micron lapping film for an initial polish followed by 0.3 micron lapping film for the final polish.
10. Label each termination point.
11. Tag each cable in junction boxes, manholes and handholes. Provide permanent nylon/plastic tie-wrap type tags with waterproof markings.
12. Make the following field tests after cable installation:
  - a. Visually inspect terminal connectors for out-of-round conditions and surface defects such as micro-chips and cracks using a 100X (minimum) inspection microscope.
  - b. Check optical continuity of each fiber from terminal to terminal.
  - c. Verify the calculated attenuation power losses of each fiber from the transmit and receive terminals at the source of each data communications loop. The light source and operating wavelength of the test equipment shall be representative of the actual operating equipment.

### 3.02. WIRE COLOR CODE

- A. All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.
- B. The following coding shall be used:

System	Wire	Color
240/120 Volts Single-Phase, 3 Wire	Neutral	White
	Line 1	Black
	Line 2	Red
208Y/120, Volts 3 Phase, 4 Wire	Neutral	White
	Phase A	Black
	Phase B	Red
	Phase C	Blue
240/120 Volts 3 Phase, 4 Wire delta, center tap ground on phase coil A-C	Neutral	White
	Phase A	Black
	Phase B (High)	Orange
	Phase C	Blue
480Y/277 Volts 3 Phase, 4 Wire	Neutral	White
	Phase A	Brown
	Phase B	Orange

- C. Neutral or ground wires that terminate in a Panelboard and require color tape shall have the color tape extend at least 6-in from the termination point.

3.03.      TERMINATIONS AND SPLICES

- A. Power conductors: Unless otherwise indicated on the Drawings, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling for copper conductors # 4 AWG and larger. Splices shall be solderless pressure connectors with insulating covers for copper conductors # 6 AWG and smaller. Aluminum conductors (where specified) shall employ terminations and splices specifically designed for aluminum conductors.
- B. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors.
- C. Instrumentation Signal Conductors (including graphic panel, alarm, low and high level signals): terminations same as for control conductors. Splices allowed at instrumentation terminal boxes only.
- D. Except where permitted by the Engineer no splices will be allowed in manholes, handholes or other below grade located boxes.
- E. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc), conduit bodies, etc.

3.04.      INSTRUMENTATION CABLES

- A. Instrumentation cables shall be installed in rigid steel raceways as specified. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.
- B. Terminal blocks shall be provided at all instrument cable junction and all circuits shall be identified at such junctions.
- C. Shielded instrumentation wire, coaxial, data highway, I/O and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels.
- D. Ground shielding on instrumentation wires at one end only as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.
- E. Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from all other (i.e. power, control, etc.) cables in manholes by enclosing them within rigid steel raceways and boxes.

- F. Shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. The tubing shall extend 1-in minimum over the jacket end and extend 0.5-in minimum from the jacket end over the exposed conductors.

3.05. FIELD TESTING

- A. Test all 600 Volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 Volts DC. Test duration shall be one minute. Submit a written test report of the results to the Engineer. Notify the Engineer in writing 48 hours prior to testing.
- B. Field testing and commissioning shall be done in accordance with the latest revision of the “Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems” published by the International Electrical Testing Association (NETA Standard ATS-1999) unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.

END OF SECTION

## SECTION 261410

### WIRING DEVICES

#### PART 1 PART 1 GENERAL

##### 1.01. 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and install wiring devices as shown on the Drawings and as specified herein.
- B. Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

##### 1.02. REFERENCE STANDARDS

- A. Wiring devices shall comply with the requirements of the National Electric Code (NEC) and shall be Underwriters Laboratories (UL) labeled.

#### PART 2 PART 2 PRODUCTS

##### 2.01. MATERIALS

- A. Wall switches shall be heavy duty, specification grade, toggle action, flush mounting quiet type. All switches shall conform to the latest revision of Federal Specification WS 896. Wall switches shall be suitable for the area classification indicated and shall be of the following types and manufacturer:
  - 1. Single pole, 20 Amp, 120/277 Volt - Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.
  - 2. Double pole, 20 Amp, 120/277 Volt - Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.
  - 3. Three way, 20 Amp, 120/277 Volt - Cooper Wiring Devices, Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.
  - 4. Four way, 20 Amp, 120/277 Volt - Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.
- B. Receptacles shall be heavy duty, specification grade of the following types and manufacturer or equal. Receptacles shall conform to Fed Spec WC596-F.
  - 1. Duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire; Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.
  - 2. Weatherproof/corrosion resistant single, 20 Amp, 125 Volt, 2 Pole, 3 Wire, with cover; Crouse-Hinds Co., "weatherproof while in use"; Appleton Electric; Pass & Seymour or equal.

3. Weatherproof/corrosion resistant duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, with cover; Crouse-Hinds Co "weatherproof while in use"; Appleton Electric; Pass & Seymour or equal.
4. Ground fault interrupter, duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, GFCI feed thru type with "test" and "reset" buttons. Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.

C. Device Plates

1. Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be as follows:
  - a. Administration type buildings: Smooth, high impact nylon of the same manufacturer and color as the device. Final color shall be as selected by the Architect.
  - b. Where permitted in other areas of the plant, flush mounted devices in cement block construction shall be Type 302 high nickel (18-8) stainless steel of the same manufacturer as the devices.
2. Plates for indoor surface mounted device boxes shall be cast metal of the same material as the box, Crouse-Hinds No. DS23G and DS32G; Appleton FSK1DRC, FSK1TSEC; Pass & Seymour or equal.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Switch and receptacles outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypsum board construction, in dry areas with cement block construction or when raceways are shown as concealed on the Drawings.
- B. Do not install flush mounted devices in areas designated DAMP, WET or WET/CORROSIVE on the Drawings. Provide surface mounted devices in these areas.
- C. Provide weatherproof devices covers in areas designated WET or WET/CORROSIVE on the Drawings.
- D. Convenience outlets shall be 15-in above the floor unless otherwise required.
- E. Convenience outlets installed outdoors and in rooms where equipment may be hosed down shall be 18-in above floor or grade.
- F. Switches and dimmer controls for lighting shall be mounted 48-in above the finished floor unless otherwise noted or required.
- G. The location of all devices is shown, in general, on the Drawings and may be varied within reasonable limits so as to avoid any piping or other obstruction without extra cost, subject to the approval of the Engineer. Coordinate the installation of the devices for piping and equipment clearance.

END OF SECTION

## SECTION 261910

### MISCELLANEOUS EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.

##### 1.02 EQUIPMENT LIST

- A. This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

#### PART 2 PRODUCTS

##### 2.01. MATERIALS

###### A. Disconnect Switches

1. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle. All current carrying parts shall be copper
2. NEMA 4 enclosures shall be stainless steel.
3. NEMA 4X enclosures shall be stainless steel.
4. Switches shall be as manufactured by the Square D Co.; General Electric; Cutler-Hammer, or equal.

###### B. Fused Disconnect Switches

1. Fused disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle. All current carrying parts shall be copper.
2. Fuses shall be rejection type, 600 Volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron, Class RK-5 or equal.
3. NEMA 4 enclosures shall be stainless steel.
4. NEMA 4X enclosures shall be stainless steel.
5. Switches shall be as manufactured by the Square D Co.; General Electric; Cutler-Hammer, or equal.

###### C. Horsepower Rated, Toggle Switch Type Disconnect Switch

1. Toggle type disconnect switches shall be manufactured of thermoplastic materials with screw-type terminals. The switches shall be rated 600 VAC and 20A at 600 VAC.
2. Toggle type disconnect switches shall be similar to a manual non-reversing starter without overloads and shall be 3 Pole, capable of “on-off” control of a 10 horsepower motor at 460 VAC.
3. Enclosure shall be provided with lock off provisions.
4. NEMA 4 enclosures shall be die-cast zinc.
5. Switches shall be as manufactured by the Square D Co.; Siemens Electrical Products; Cutler-Hammer or equal.

D. Detectable Warning Tape

1. Each duckbank section shall be marked by means of a detectable warning tape (tracer tape) as shown on the Drawings. The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.
2. The detectable warning tape shall consist of 5 mil (.005-in) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 pounds of tensile break strength minimum per 6-in width.
3. The top side of the tracer tape shall be color banded red for electrical and high voltage lines, and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be 4-in wide with four color bands. The tape shall be inscribed with the warning message for the utility such as “CAUTION – ELECTRICAL LINED BURIED BELOW”. Tape shall be as manufactured by Mutual Industries, Inc.; Terra Tape, Div. of Reef Industries Inc. or equal.

E. Terminal Blocks

1. Terminal blocks shall be NEMA type rated at 20 amperes minimum, 600 Volt, channel mounted, with tubular screw and pressure plate.
2. Terminal blocks shall be Bulletin 1492 as manufactured by the Allen-Bradley Co.; ABB; Kukla, or equal.

F. Equipment Identification Nameplates

1. All field mounted electrical equipment such as disconnects, push button stations, etc, shall be provided with a weather resistant engraved laminoid equipment identification nameplate screwed or bolted adjacent to the device. Nameplate shall identify the mechanical equipment controlled exactly as shown on the electrical singleline drawings (i.e, P-95 Cooling Water Pump No. 1).

G. Arc Flash Protection Warning Signs



1. Provide field-affixed arc flash warning labels on all switchboards, panelboards, industrial control panels, and motor control centers in accordance with National Electrical Code Article 110.16.
2. As a minimum, warning signs shall state “WARNING: Arc Flash and Shock Hazard, Appropriate PPE required”, and shall be designed in accordance with ANSI Z535.4-1998. Where available from the equipment manufacturer, additional information including Flash Hazard boundary, incident energy, voltage shock hazard, PPE required, etc. shall be provided.

### PART 3 EXECUTION

#### 3.01. INSTALLATION

##### A. A. Mounting Stands

1. Field mounted disconnects, pushbutton control stations, alarm panels, enclosed starters and circuit breakers, transformers, automatic transfer switches, wireways, contactors, terminal boxes, junction and pull boxes shall be mounted on galvanized or stainless steel stands as specified. Where clearance requirements for stands may not be maintained, the Engineer may direct electric control equipment to be wall-mounted adjacent to the driven equipment, but in no case shall the distance from the drive motor to the control station exceed 3-ft, all at no additional cost to the Owner.
  2. Channel supports shall be ground smooth and fitted with plastic end caps.
- B. All panelboards located in pedestal cabinets or outdoors and panelboards that have branch circuits feeding exterior to the building shall be equipped with lightning arresters and surge capacitors.

#### 3.02. FIELD TESTING

- A. Before supplying power to the alarm panels, the following tests shall be done: Verify that all wiring connection interfaces that are required are present. Check for secure connections. Using a continuity device, verify that all discrete inputs and output to and from the control panel are wired in correct polarity and are operating in the correct state of operation (normally open or closed state). Check for any direct short circuits across all voltage supply sources. As each of the above tests are performed, the Electrical Contractor shall highlight and initial each circuit that is tested. This set of prints shall be signed and left inside the enclosure.
- B. Check mechanical interlocks for intended operation. Make any adjustments required.
- C. In the event of an equipment fault in the panel, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor and Engineer. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service at no additional cost to the Owner.

END OF SECTION



## SECTION 262890

### SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes both field-mounted SPDs and integrated SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

##### 1.2 DEFINITIONS

- A.  $I_{(n)}$ : Nominal discharge current rating.
- B. MCOV: Maximum continuous operating voltage.
- C. Protection Modes: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

##### 1.3 SUBMITTALS

- A. Product Data:
  - 1. For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Provide verification the SPD is listed or recognized through Underwriters Laboratories to the latest Safety Standard, ANSI/UL 1449 3<sup>rd</sup> Edition.
  - 3. Operations and Maintenance Data: SPDs to include operation, and maintenance manuals.
  - 4. Warranties: Sample of special warranties.

##### 1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or repair SPDs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Ten years.

## PART 2 - PRODUCTS

### 2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by Underwriters Laboratories, and marked for intended location and application.
- B. Comply with Underwriters Laboratories ANSI/UL 1449 3<sup>rd</sup> Edition – Surge Protective Devices.
- C. Comply with Underwriters Laboratories ANSI/UL 1283 5<sup>th</sup> Edition – Electromagnetic Interference Filters. (Applies to Type 2 SPDs)
- D. Designed in accordance with ANSI/IEEE C62.41.1-2002, C62.41.2-2002 and C62.45-2002
- E. SPDs manufacturer shall be ISO-9001 certified.
- F. MCOV of the SPD shall not be less than 115% for 480Y/277V and 125% for 208Y/120V nominal RMS system voltages.
- G. SPDs shall be installed internal to the distribution equipment and shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

- UL 67 = Panelboards
- UL 845 = Motor Control Centers
- UL 857 = Busway
- UL 891 = Switchboards
- UL 1558 = Low Voltage Switchgear

### 2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide SquareD Surgellogic branded Surge Protection, or comparable product by one of the following:
  - 1. Square D by Schneider Electric
  - 2. Cutler-Hammer
  - 3. Siemens
  - 4. GE

### 2.3 SERVICE ENTRANCE SUPPRESSOR

- A. SPDs: Comply with UL 1449 3<sup>rd</sup> Edition.
  - 1. SPD Type – All SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. SPDs installed on the load side of the service entrance OCPD shall be either Type 1 or Type 2 SPDs.
  - 2. Type 2 SPDs shall also comply with ANSI/UL 1283.
- B. SPDs shall be provided with the following features and accessories:
  - 1. Integral disconnect switch.

2. Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.
3. Indicator light(s) display for power and protection status.
4. Audible Alarm with silencing switch.
5. Form-C contacts- One normally open and one normally closed for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
6. Surge counter with reset switch.

C. Surge Current Rating: The surge current rating of the SPD shall be dependent of its Category/Location:

Category/Location	Application	Per Phase	Per Mode
C	Service Entrance	240 kA	120 kA
B	Distribution	160 kA	80 kA

Protection modes: UL 1449 **VPR** for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 V	1200 V	1500 V
L-L	1200 V	2000 V	2500 V

Protection modes: UL 1449 **VPR** for Delta configured circuits shall not exceed the following:

Modes	240D	480D	600D
L-G; N-G	1200 V	2000 V	2500 V

- D. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.
- E. Nominal Discharge Current Rating: 20 kA  $I_{(n)}$

Note: Surge Protective Devices must carry a minimum Nominal Discharge Current Rating of 20kA to meet the requirements for UL96A – Installation Requirements for Lightning Protection Systems.

## 2.4 PANELBOARD SUPPRESSORS

- A. SPDs: Comply with UL 1449 3<sup>rd</sup> Edition.
  1. Type 1 or Type 2 SPD

2. Type 2 SPDs shall also comply with UL 1283.
- B. SPDs shall be provided with the following features and accessories:
1. Indicator light(s) for power and protection status.
  2. Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.
  3. Audible Alarm with silencing switch.
  4. Form-C contacts - One normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
  5. Surge counter with reset switch.
- C. Surge Current Rating: The surge current rating of the SPD shall be dependent of its Category/Location:

Category/Location	Application	Per Phase	Per Mode
B	Distribution	160 kA	80 kA
B	Branch	120 kA	60 kA

Protection modes: UL 1449 **VPR** for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 V	1200 V	1500 V
L-L	1200 V	2000 V	2500 V

Protection modes: UL 1449 **VPR** for Delta configured circuits shall not exceed the following:

Modes	240D	480D	600D
L-G; N-G	1200 V	2000 V	2500 V

- D. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.
- E. Nominal Discharge Current Rating: Minimum of 10 kA  $I_{(n)}$
- 2.5 ENCLOSURES
- A. Enclosure shall meet or exceed the ratings for the environment to be installed as indicated on drawings.

1. Indoor Enclosures: NEMA 250, Type 3R
2. Outdoor Enclosures: NEMA 250, Type 3R, 4X

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. SPD devices at distribution panels or switchboards shall be mounted integral to the equipment with leads as short as possible (not to exceed 24-in) and the lead size shall be a minimum of 6 AWG or larger. The SPD shall include an integral disconnect switch which has been tested to the surge current rating of the SPD and shall match or exceed the fault current rating of the board. The disconnect switch shall switch the phases and neutral.
- B. SPD devices at branch panels shall be direct bus-to-bus connected with leads as short as possible (not to exceed 24-in) and lead size shall be a minimum of 6 AWG or larger.
- C. Install SPD devices at the service entrance in accordance to NFPA 70. All SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. All SPDs installed on the load side of the OCPD shall be either Type 1 or Type 2 SPDs.
- D. Follow manufacturers recommended installation practices.
  1. Provide a minimum 30 Amp circuit breaker as a dedicated disconnecting means for the SPD unless otherwise indicated.
  2. Install SPDs with properly rated conductors between suppressor and points of attachment as short and straight as possible; adjust circuit-breaker positions to achieve shortest and straightest leads.
  3. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
  4. Twist input conductors together to reduce the input inductance.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
  1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  2. Inspect anchorage, alignment, grounding, and clearances.
  3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass inspections.
- C. Prepare inspection reports.

### 3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.

- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect all wires, including neutral of the SPD before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION



## SECTION 264700

### PANELBOARDS

#### PART 1 GENERAL

##### 1.01. SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all panelboards as shown on the Drawings and as specified herein.

##### 1.02. REFERENCE STANDARDS

- A. Panelboards shall be in accordance with the Underwriter Laboratories (UL) "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

##### 1.03. MANUFACTURERS

- A. 120/240 Volt, single phase, 3 Wire and 120/208 Volt, 3 Phase, 4 Wire panelboards shall be Sentron Type P1 as manufactured by Siemens; Type NQOD by Square D Co.; Type Pow-R-Line C by Cutler-Hammer; or Type AQ as manufactured by the General Electric Co.
- B. NEMA 3, 4 and 12 panelboards shall be similar to those specified above with appropriate enclosure modifications as required by voltage application. Panel enclosures shall be provided as specified in Section 16000 and 16110.

#### PART 2 PRODUCTS

##### 2.01. GENERAL

- A. Rating
  - 1. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.
  - 2. Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

##### 2.02. MATERIALS (NEMA 1)

- A. Interiors

1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.
2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.
3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.
4. A nameplate shall be provided listing manufacturer's name, panel type and rating.

B. Buses

1. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
3. Spaces, provision for future breakers, shall have bus straps bolted onto the bus so that future breakers can be bolted into the panel.
4. Equipment ground bars shall be furnished.

C. Boxes

1. Recessed or flush mounted boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of 4-in on all sides.
2. Surface mounted boxes and trims shall have an internal and external finish as specified in Paragraph 2.04D4 below. Surface mounted boxes shall be field punched for conduit entrances.
3. At least four studs for mounting the panelboard interior shall be furnished.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.
3. The trims shall be fabricated from code gauge sheet steel.

4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
5. Trims for flush panels shall overlap the box by at least 3/4-in all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.
6. Door-in-door type construction shall be provided so that trim may be opened to access wire ways without removing the trim from the panel

#### 2.03. MATERIALS (NEMA 3, 4 and 12)

##### A. Interiors and Buses

1. Interiors and buses shall be as hereinbefore specified for NEMA 1 construction.

##### B. Boxes and Covers

1. Boxes and covers shall be made from painted galvanized steel with natural finish.
2. Boxes and covers shall be bolted together and gasketed.
3. Conduit openings shall be tapped.

#### 2.04. CIRCUIT BREAKERS

- A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
- B. Circuit breakers shall be molded case, bolt-in type.
- C. Circuit breakers shall be as manufactured by the panelboard manufacturer.

### PART 3 EXECUTION

#### 3.01. INSTALLATION

- A. Mount boxes for surface mounted panelboards so there is at least 1/2-in air space between the box and the wall.
- B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.
- C. Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.
- D. Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-in high by 9-in wide, Style A as manufactured by W.H. Brady Co. or equal.

- E. Install a 1-in by 3-in laminated plastic nameplate with 1/4-in white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be stainless steel screw mounted.

END OF SECTION

## SECTION 26600

### UNDERGROUND SYSTEM

#### PART 1 GENERAL

##### 1.01. SCOPE OF WORK

- A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein.
- B. All underground systems shall be encased as shown on the drawings.
- C. The Contractor shall be responsible for setting manholes and handholes at the proper elevation such that the pitch of raceways will be towards manholes and handholes and away from structures, vaults and buildings.
- D. Where referred in this Section, raceways are underground conduits – Ductbanks are a collection of underground raceways. Underground system is the collection of underground raceways, manholes and handholes.
- E. Ductbanks shall be constructed as shown on the drawings up to the building, structure, vault, manhole and handhole.
  - 1. Ductbank, manhole and handhole depths vary. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required depths and install raceways, manholes and handholes at that required depth at no additional cost to the Owner.
  - 2. Ductbank routing and manhole/handhole locations shown on the Drawings are diagrammatically depicted. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths at no additional cost to the Owner.

#### PART 2 PRODUCTS

##### 2.01. MATERIALS

- A. Raceways shall be polyvinyl chloride conduit.
- B. Cable racks, supports, pulling-in irons, manhole steps and hardware shall be galvanized steel as manufactured by Line Materials Co.; Underground Devices, Inc.; Chance or equal.
- C. Ground rods and other grounding materials and methods shall be as specified.
- D. Bell ends and plastic duct spacers shall be as manufactured by Carlon; Underground Devices Inc. or equal.
- E. Pull line for spare conduits shall be 1/8-in nylon rope.
- F. Detectable Warning Tape

1. Each duckbank section shall be marked by means of a detectable warning tape (tracer tape) as shown on the Drawings. The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.
2. The detectable warning tape shall consist of 5 mil (.005-in) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 pounds of tensile break strength minimum per 6-in width.
3. The top side of the tracer tape shall be color banded red for electrical and high voltage lines, and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be 4-in wide with four color bands. The tape shall be inscribed with the warning message for the utility such as "CAUTION – ELECTRICAL LINED BURIED BELOW". Tape shall be as manufactured by Mutual Industries, Inc.; Terra Tape, Div. of Reef Industries Inc. or equal.

### PART 3 EXECUTION

#### 3.01. INSTALLATION

- A. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3-in per 100-ft.
- B. Use plastic spacers located not more than 4-ft apart to hold raceways in place. Spacers shall provide not less than 2-in clearance between raceways and edge of envelope.
- C. The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Engineer.
- D. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings for steel conduit.
- E. Where bends in raceways are required, use long radius elbows, sweeps and offsets.
- F. Swab all raceways clean before installing cable.
- G. Plug and seal spare raceways watertight at all manholes, buildings and structures.
- H. Seal the ends of raceways and make watertight at all manholes, buildings and structures.
- I. Install pulling-in irons opposite all raceway entrances to manholes.
- J. Train cables in manholes and handholes and support and restrain them on racks and hooks. Furnish inserts on all manhole and handhole walls for mounting future racks as well as racks required for present installation.
- K. PVC Coated Rigid galvanized steel conduit shall be used for elbows and risers at the utility pole for electrical and telephone service conduits.
- L. PVC coated rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups and all stub-ups through concrete floors, walls and slabs.
- M. A pull line shall be installed and left in all spare raceways.

- N. Install detectable warning tape in all ductbanks as shown on the Drawings. Where trench exceeds 24-in width, provide additional detectable tape runs to mark each side of the ductbank in addition to the one in the center.
- 3.02. CLEANING
- A. All new manholes and handholes shall be thoroughly cleaned of all silt, debris and foreign matter prior to final inspection.

END OF SECTION





## SECTION 26660

### GROUNDING SYSTEM

#### PART 1 GENERAL

##### 1.01. SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code NEC.
- B. All raceways, conduits, ducts and multi-conductor cables shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

1.02. A supplemental grounding conductor shall be provided from each switchgear, switchboard, motor control center, power panelboard, lighting panelboard, to the buried ground grid. Supplemental grounding conductors shall be installed in PVC Schedule 80 conduit.

#### PART 2 PRODUCTS

##### 2.01. MATERIALS

- A. Conduit shall be as specified under Section 16110.
- B. Wire shall be as specified under Section 16120.
- C. Ground rods shall be 3/4-in by 10-ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm. Ground rods shall be Copperweld; Blackburn; Erico, Inc. or equal.
- D. Grounding conduit hubs shall be malleable iron type, and of the correct size for the conduit, as manufactured by Thomas & Betts Co.; Catalog No. 3940 Series, similar by Burndy; O.Z. Gedney Co. or equal.
- E. Water pipe ground clamps shall be cast bronze saddle type, and of the correct size for the pipe, as manufactured by Thomas & Betts Co. Cat. No. 2 (1/2-in, 3/4-in, or 1-in size), similar by Burndy; O.Z. Gedney Co. or equal and of the correct size for the pipe.
- F. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.
  - 1. Molds, cartridge materials and accessories shall be provided in kit form and selected per the manufacturer's written instructions for specific types, sizes and combinations of conductors and connected items. Molds and powder shall be furnished by the same manufacturer.

#### PART 3 EXECUTION

##### 3.01. INSTALLATION

- A. Run grounding electrode conductors in rigid steel conduits. Bond the protecting conduits to the grounding electrode conductors at both ends. Do not allow water pipe connections to be painted. If the connections are painted, dis-assemble them and re-make them with new fittings.
  - B. Install equipment grounding conductors with all feeders and branch circuits.
  - C. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus, as shown on the Drawings.
  - D. Ground wire connections to structural steel columns shall be made with exothermic welds.
  - E. Metal conduits stubbed into a motor control center or floor mounted electrical enclosure shall be terminated with insulated grounding bushings and connected to the motor control center or electrical enclosure ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250-122, except that a minimum No. 12 AWG shall be used.
  - F. Liquid tight flexible metal conduit in sizes 1-1/2-in and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.
  - G. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250-66.
  - H. Drive grounding electrodes as shown on the Drawings.
  - I. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.
  - J. Seal exposed connections between different metals with No-Oxide Paint Grade A or equal.
  - K. Ground metal poles supporting outdoor lighting fixtures to a supplemental grounding electrode (rod) in addition to the separate equipment grounding conductor run with the supply branch circuit.
  - L. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate in accordance with NEC Paragraph 250.52 using a minimum of 20-ft of bare copper conductor not smaller than No. 4 AWG. Where base of foundation is less than 20-ft in length, coil excess conductor within base of concrete foundation. Extend grounding conductor below grade and connect to building grounding grid, ground loop, or grounding electrode external to concrete.
- 3.02. INSPECTION AND TESTING
- A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.
  - B. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance to ground of the system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

- C. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.
- D. Testing shall be performed before energizing the distribution system.
- E. Test all grounded cases and metal parts associated with the electrical equipment for continuity with the ground system.
- F. Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms.

END OF SECTION



SECTION 31 1100  
SITE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required and perform all site preparation, complete as shown on the Drawings and as specified herein.
- B. Obtain all permits required for site preparation work prior to proceeding with the work, including clearing, burning.

1.02 RELATED WORK

- A. Earthwork is included in Section 31\_2000.
- B. Topsoil and Seeding is included in Section 31\_2900.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01\_3000, copies of all permits required prior to clearing, grubbing, and stripping work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

- A. Cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish and any other objectionable material resting on or protruding through the surface of the ground.
- B. Preserve and protect trees and other vegetation designated on the Drawings or directed by the Engineer to remain as specified below.
- C. Unless otherwise specified in these specifications or in the Plans, the CONTRACTOR shall replace all sod, shrubs, bushes, trees, and flowers disturbed or removed, that are located upon improved or landscaped public and private property. The CONTRACTOR shall replant vegetation and re-landscape or cause such to be performed throughout the work area as soon as possible after the pipelines and appurtenances have been installed. All vegetation damaged during or after removal shall be replaced with healthy vegetation of the same kind or type. All plants shall be replanted as close as possible to the original location or approved by the property UTILITY and or the utility. The CONTRACTOR shall maintain all such replanted vegetation by the application of water, fertilizers, and topsoil. The vegetation shall be cultivated to prohibit the growth of foreign vegetation until a well-developed root system has been established and transplanted vegetation has overcome the "shock" resulting from transplanting. The CONTRACTOR shall replace all vegetation that dies or becomes unhealthy. The contour of the ground shall be left as near the original contour as possible.

3.02 GRUBBING

- A. Grub and remove all stumps, roots in excess of 1-1/2-in in diameter, matted roots, brush, timber, logs, concrete rubble and other debris encountered to a depth of 18-in below original grade or 18-in beneath the bottom of (foundations) (and) (roadway subbase) whichever is deeper.

- B. Refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density conforming to the surrounding ground surface in accordance with Section 02200.

### 3.03 STRIPPING

- A. Strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.
- B. Topsoil shall be free from brush, trash, large stones and other extraneous material. Avoid mixing topsoil with subsoil.
- C. Stockpile and protect topsoil until it is used in landscaping, loaming and seeding operations. Dispose of surplus topsoil after all work is completed.

### 3.04 DISPOSAL

- A. Cut tree trunks and limbs exceeding 4-in in diameter shall be cut into 4-ft lengths and stockpiled on site in the area designated by the UTILITY.
- B. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved offsite disposal area. No rubbish or debris of any kind shall be buried on the site.
- C. On-site disposal of cleared and grubbed materials by open-air burning may be permitted only with the expressed written consent of the UTILITY. Burning operations and ash disposal shall be conducted in strict accordance with local and state requirements, subject to applicable permit requirements.

### 3.05 PROTECTION

- B. Trees and other vegetation designated on the Drawings or directed by the Engineer to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards and enclosures, or by other approved means. Conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed and so as to provide for the safety of employees and others.
- B. Maintain protection until all work in the vicinity of the work being protected has been completed.
- C. Do not operate heavy equipment or stockpile materials within the branch spread of existing trees.
- D. Immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work shall immediately be cut off cleanly inside the exposed or damaged area.
- E. When work is completed, remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches.
- F. Restrict construction activities to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the UTILITY. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations, shall be promptly restored to their original condition, to the full satisfaction of the property UTILITY.

END OF SECTION

## SECTION 31 2000

### EARTHWORK

#### PART 1 GENERAL

##### 1.00 STATUTORY REQUIREMENTS

- A. All excavation, trenching, sheeting, bracing, etc shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P), and State and local requirements. Where conflict between OSHA, State and local regulations exists, the most stringent requirements shall apply.

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all excavation work and grading; place and compact backfill and fill; and dispose of unsuitable, waste and surplus materials as shown on the Drawings and as specified herein.
- B. Provide the services of a licensed professional engineer registered in the State in which the work is located, to prepare temporary excavation support system designs and submittals.
- C. Furnish and install temporary excavation support systems, including sheeting, shoring and bracing, to ensure the safety of personnel and protect adjacent structures, piping, etc, in accordance with Federal, State and local laws, regulations and requirements.

##### 1.02 RELATED WORK

- A. Site Preparation is included in Section 31\_1100.
- B. Trenching, Backfilling and Compaction is included in Section 31\_2300.
- C. Fill and Backfill Materials are included in Section 31\_2330.
- D. Erosion and Sedimentation Control are included in Section 31\_2500.
- E. Topsoil and Seeding are included in Section 31\_2900.

##### 1.03 SUBMITTALS

- A. Excavation support system designs shall be prepared by a licensed professional engineer, registered in the State in which the work is located, having a minimum of 5 years of professional experience in the design and construction of excavation support systems. Submit an original and three copies of the licensed professional engineer's certification, on the PE form specified in Section 01\_3000, stating that the excavation support systems designs have been prepared by the professional engineer and that the professional engineer will be responsible for their execution. Do not submit excavation support system designs unless requested in writing.

##### 1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

##### 1.05 QUALITY ASSURANCE

- A. At all structures, prior to the placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with a soils testing laboratory to verify the suitability of the existing subgrade soil and to perform in-place soil density tests as required to verify that the bearing capacity of the subgrade is sufficient. Utilize Anderson Engineering Consultants, Inc. of Little Rock, AR, or other local soils testing laboratory. A min. of 1 nuclear density test per every 2,500 sf shall be performed.
- B. Prior to and during the placement of backfill and fill for structures, coordinate with the soils testing laboratory to perform in-place soil density tests to verify that the backfill/fill material has been compacted in accordance with the compaction requirements specified elsewhere.

## 1.06 DEFINITIONS

- A. Where the phrase "in-the-dry" is used in this Section, it shall be defined to mean a soil condition such that the in-place moisture content of the soil at that time is no more than two percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction.
- B. Where used in this Section "structures" refers to all buildings, wet wells, manholes and below grade vaults. Stormwater structures and duct banks are not considered structures in this context.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Materials designated for use in this Section are specified in Section 31\_2330.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Test Pits
  1. Perform exploratory excavation work (test pits) for the purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.
  2. Test pits shall be backfilled as soon as the desired information has been obtained. Backfilled surfaces shall be stabilized in accordance with approved erosion and sedimentation control plans.
- B. Dewatering and Drainage Systems
  1. Temporary dewatering and drainage systems shall be in place and operational prior to beginning excavation work. Groundwater levels must be maintained a minimum of 2 ft. below the excavation bottom, to allow construction in the dry.

### 3.02 EXCAVATION SUPPORT

- A. Furnish, install, monitor and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc) as required by Federal, State or local laws, ordinances, regulations and safety requirements. Support the sides of excavation, to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement or other damage. Take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with common fill material. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete.
- B. Install excavation supports outside the neat lines of foundations. Supports shall be plumb and securely braced and tied in position. Excavation support shall be adequate to withstand all



pressures to which the supports will be subjected. Any movement or bulging of supports shall be corrected to provide the necessary clearances, dimensions and structural integrity.

C. Excavation Supports Left in Place

1. Excavation supports that are required to remain in place, if applicable, are indicated on the Drawings.
2. The UTILITY or Engineer may direct that certain excavation supports remain in place, or be cut off at any specific elevation. Supports directed by the UTILITY or Engineer to be left in place and not so designated on the Drawings or otherwise specified herein to remain in place, will be paid for in accordance with the Unit Price Schedule. If the CONTRACTOR believes that such a directive increases CONTRACTOR's cost and would thereby entitle CONTRACTOR to a change in contract cost, CONTRACTOR shall notify the Engineer in accordance with the applicable article(s) in the General Conditions pertaining to changes in the work.
3. The right of the UTILITY or Engineer to direct that certain excavation supports remain in place shall not be construed as creating any obligation on the UTILITY or Engineer to give such direction, nor shall failure to give such direction relieve the CONTRACTOR from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.

- D. Excavation supports shall be carefully removed in such manner so as not to endanger the Work or other adjacent structures, utilities, or property. All voids left or caused by withdrawal of supports shall be immediately filled with sand and compacted.

3.03 STRUCTURAL EXCAVATION PROCEDURES

- A. Excavations for structures shall be suitably wide for construction of the structures, including excavation supports, dewatering and drainage systems and working clearances.
- B. Excavation shall be performed in-the-dry and shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Drainage and dewatering systems shall be in place and operational prior to beginning excavation work. In no case shall the earth be plowed, scraped or excavated by any means so near to the finished subgrade that would disturb the finished subgrade. Hand excavation of the final 3 to 6-in may be required to obtain a satisfactory, undisturbed subgrade. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures as a result of inadequate excavation, dewatering, or other construction methods shall be removed and replaced with lean concrete, compacted structural fill or suitable crushed rock, subject to prior approval by the Engineer, at no additional cost to the UTILITY.
- C. Subgrade Preparation
1. All structures unless otherwise shown on the Drawings or otherwise specified herein:
    - a. Compact the top 12-in of subgrade to a minimum of 95 percent modified proctor (ASTM D1557).
    - b. Where structures are supported by piles, compact the top 12-in of subgrade to a minimum of 90 percent modified proctor (ASTM D1557).
  2. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Prior to placing the lean concrete working mat, compact the top 12-in of existing subgrade to a minimum of 95 percent modified proctor (ASTM D1557).

- D. When excavations have reached the required subgrade, including any allowances for working mats or base materials, prior to the placement of working mats or base materials, notify the soils testing laboratory to verify the suitability of the existing subgrade soils for the anticipated foundation and structural loadings. If the existing subgrade soils are determined to be unsuitable, direction will be provided by the Engineer regarding removal and replacement with suitable materials. If CONTRACTOR believes that such direction would increase CONTRACTOR's cost and would thereby entitle CONTRACTOR to a change in Contract cost, CONTRACTOR shall notify the Engineer in accordance with the applicable article(s) in the General Conditions pertaining to changes in the work.
- E. Over-excavation beyond the limits and depths required by the Contract Documents shall be replaced at no additional cost to the UTILITY by low density cellular concrete or other approved material subject to the prior approval of the Engineer.

#### 3.04 GENERAL FILLING AND BACKFILLING PROCEDURES

- A. Fill and backfill materials shall be placed in lifts to suit the specified compaction requirements to the lines and grades required, making allowances for settlement and placement of cover materials (i.e. topsoil, sod, etc). Soft spots or uncompacted areas shall be corrected.
- B. Fill and backfill materials shall not be placed on frozen surfaces, or surfaces covered by snow or ice. Fill and backfill material shall be free of snow, ice and frozen earth.
- C. Compaction in open areas may be accomplished by any of the following methods: compaction equipment, fully loaded ten-wheel trucks, tractor dozers weighing at least 30,000 lbs and operated at full speed, or heavy vibratory rollers. Compaction in confined areas (including areas within a 45-degree angle extending upward and outward from the base of a wall) and in areas where the use of large equipment is impractical, shall be accomplished by hand operated vibratory equipment or mechanical tampers. Lift thickness shall not exceed 6-in (measured before compaction) when hand operated equipment is used.
- D. Fill and backfill shall not be placed and compacted when the materials are too wet to properly compact (i.e. the in-place moisture content of the soil at that time is no more than three percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction).

#### 3.05 FILL AND BACKFILL PROCEDURES

- A. Fill required beneath foundations or slabs on grade (except sidewalks) shall be structural fill (AHTD Class 7 Base Course). Place and compact structural fill in even lifts having a maximum thickness (measured before compaction) of 8-in.
- B. Fill and backfill material placed immediately adjacent to and within 5-ft of all structures shall be structural fill. All structure water-tightness tests and dampproofing/waterproofing shall be completed prior to placing fill or backfill around structures. Place and compact select fill in even lifts having a maximum thickness (measured before compaction) of 8-in uniformly around the structure.
- C. Common fill may be used in areas beyond those designated for structural fill unless shown or specified otherwise. Common fill shall be placed in even lifts having a maximum thickness (measured before compaction) of 12-in.

#### 3.06 EMBANKMENT FILL PROCEDURES

- A. Prior to placing embankment fill materials, all organic materials (including peat and loam) and loose inorganic silt material (loess) shall be removed from areas beneath the embankments. If the subgrade slopes are excessive, the subgrade shall be stepped to produce a stable, horizontal surface for the placement of embankment materials. The existing subgrade shall then be scarified to a depth of at least 6-in.

- B. Embankment fill shall consist of common fill material and shall be placed and compacted in even lifts (measured before compaction) of 12-in.
- C. Rock may be used in embankment fill only with prior, written approval of the Engineer.

### 3.07 COMPACTION REQUIREMENTS

- A. Beneath foundations and slabs on grade (except sidewalks): Compact the top 12-in of existing subgrade and each layer of fill to a minimum of 95 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).
- B. 5-ft around structures: Compact the top 12-in of existing subgrade and each layer of fill or backfill to a minimum of 90 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).
- C. Fill beneath structures: Compact fill below structures to a minimum of 95 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).
- C. Embankments (except under roadways), lawn or unimproved areas: Compact the top 6-in of existing subgrade and each layer of fill or backfill to a minimum of 90 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 1 to plus 4 percent).
- D. Sidewalks: Compact the top 6-in of existing subgrade (and each 6-in layer of fill if applicable) to a minimum of 90 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).
- E. Roads, paved areas and roadway embankments: Compact the top 12-in of existing subgrade and each layer of fill or backfill to a minimum of 95 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).

### 3.08 DISPOSAL OF UNSUITABLE, WASTE AND/OR SURPLUS EXCAVATED MATERIAL

- A. Unsuitable, waste and surplus excavated material shall be removed and disposed of on-site, in areas approved by the OWNER. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restrict access to the work site.

### 3.10 GRADING

- A. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of. Subgrades shall be completely and continuously drained and dewatered throughout the grading process. Install temporary drains, drainage ditches, etc, to intercept or divert surface water which may affect the execution or condition of grading.
- B. If at the time of grading it is not possible to place any material in its proper section of the Work, it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.
- C. Stones or rock fragments larger than 4 in in their greatest dimensions will not be permitted within the top 6 in of the finished grade of fills and embankments.
- D. In cut areas, all loose or protruding rocks in slopes shall be removed to line or finished grade of the slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section and alignment shown on the Drawings unless otherwise directed by the Engineer.

END OF SECTION



## SECTION 31 2300

### TRENCHING, BACKFILL, AND COMPACTION

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.
- B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.
- C. Furnish and place all sheeting, bracing and supports and shall remove from the excavation all materials which the Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.
- D. All excavation, trenching and related sheeting, bracing, etc, shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P) and all State and local requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.
- E. Wherever the requirement for percent compaction is referred to herein it shall mean "at least the specified percent of maximum density as determined by ASTM D698.
- F. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer for review.

##### 1.02 RELATED WORK

- A. Granular fill material is included in Section 31\_2330.
- B. Topsoil and seeding is included in Section 31\_2900.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION

##### 3.01 TRENCH EXCAVATION

- A. Trench excavation shall include material of every description and of whatever substance encountered. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.
- B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the CONTRACTOR's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the General Conditions and General Requirements.

- D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Trench width shall be the practical minimum.
- E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced by screened gravel fill as required by the Engineer at the CONTRACTOR's expense.
- F. Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 1-ft of depth.
- G. Where pipe is to be laid in screened gravel bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- H. Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing a flat-bottom true to grade upon undisturbed material. Bell holes shall be made as required.

### 3.02 DISPOSAL OF MATERIALS

- A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and gate valves. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified below.
- B. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stored at a location provided. When required, it shall be re-handled and used in backfilling the trench.
- C. The CONTRACTOR shall dispose of excess material at an area off-site. Disposal costs shall be the responsibility of the CONTRACTOR.

### 3.03 SHEETING AND BRACING

- A. Furnish, put in place and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the CONTRACTOR. Compliance with such order shall not relieve the CONTRACTOR from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- C. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.
  - 1. When installing rigid pipe (R.C., V.C., A.C., etc), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the

next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.

2. When installing flexible pipe (PVC, D.I. etc), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be recompacted to provide uniform side support for the pipe.
- D. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.
- E. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.
- F. No payment will be given for sheeting, bracing, etc, during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the CONTRACTOR.
- G. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1-ft above the top of the pipe.

#### 3.04 TEST PITS

- A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

#### 3.05 EXCAVATION BELOW GRADE AND REFILL

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.
- B. If the CONTRACTOR excavates below grade through error or for the CONTRACTOR's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.
- C. If the material at the level of trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel notwithstanding effective drainage, the subgrade material shall be removed to the extent directed and the excavation refilled with a 6-in layer of coarse sand, or a mixture graded from coarse sand to pea gravel, as approved by the Engineer, to form a filter layer preserving the voids in the gravel bed of the pipe. The composition and gradation of gravel shall be approved by the Engineer prior to placement. Screened gravel shall then be placed in 6-in layers thoroughly compacted up to the normal grade of the pipe. If directed by the Engineer, bank-run gravel shall be used for refill of excavation below grade.
- D. Geotextile filter fabric may be substituted for filter layer if approved by the Engineer. Filter fabric shall be Mirafi 140N; Supac equivalent, or equal.

### 3.06 BACKFILLING

- A. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. Bedding material, as specified for the type of pipe installed, shall be placed as specified in the pipe specification sections.
- B. In areas where naturally occurring groundwater levels necessitates the dewatering of the trench, an impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as directed, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in the pipe bedding where directed or every 300-ft, whichever is less.
- C. Where the pipes are laid cross-country, the remainder of the trench shall be filled with common fill material in layers not to exceed 3-ft and mounded 6-in above the existing grade or as directed. Where a loam or gravel surface exists prior to cross-country excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the clean-up process, so that the ground may be restored to its original level and condition.
- D. Where the pipes are laid in existing paved roads, streets, alleys, driveways, and parking lots, the trench shall be backfilled from trench bottom up to a depth of 3-in below the finished surface with crushed stone compacted to 95% modified proctor density. The crushed stone layers shall be placed in lifts not to exceed 6-in. The trench shall be capped with a minimum of 3-in. of compacted asphaltic concrete cold mix to serve as a temporary driving surface until permanent repairs are made.
- E. Where the pipes are laid in proposed paved roads, streets, alleys, driveways, and parking lots, the trench shall be backfilled from trench bottom up to the finished surface with crushed stone compacted to 95% modified proctor density. The crushed stone layers shall be placed in lifts not to exceed 6-in.
- F. Where the pipes are laid in existing gravel roads, streets, alleys, driveways, and parking lots, the trench shall be backfilled from trench bottom up to the finished surface with crushed stone compacted to 95% modified proctor density. The crushed stone layers shall be placed in lifts not to exceed 6-in.
- G. When trenches pass through existing sidewalks, the trench shall be backfilled from the bedding material up to 3-in. below the finished surface with select fill material. Backfill and compaction of the select fill material shall proceed as specified in Part 3.06 D above, except the temporary cap shall be 3-in. of compacted structural fill or asphaltic concrete cold mix.
- H. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until bedding and selected material has been placed and compacted to a level 1-ft over the pipe.
- I. Bedding and backfill shall be brought up evenly on all sides. Each layer of material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to a minimum of 90 percent standard proctor density, or greater, as specified elsewhere and in the pipe specification sections. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.
- J. Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs; the material being spread and compacted in layers not over 6-in thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.



- K. Backfill around structures shall be selected common fill material, may be compacted by puddling where approved by the Engineer. All backfill shall be compacted, especially under and over pipes connected to the structures.
- L. Subject to the approval of the Engineer, fragments of ledge and boulders smaller than 6-in may be used in trench backfill providing that the quantity in the opinion of the Engineer is not excessive. Rock fragments shall not be placed until the pipe has at least 2-ft of earth cover. Small stones and rocks shall be placed in thin layers alternating with earth to ensure that all voids are completely filled. Fill shall not be dropped into the trench in a manner to endanger the pipe.
- M. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed. Frozen material shall not be used under any circumstances.
- N. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

### 3.07 TRACER WIRE

- A. A continuous 12 guage insulated (blue in color) solid copper tracing wire shall be installed with all non-metallic pipe. The wire shall be laid along the length of the pipe. The tracing wire shall be looped around valves, saddles, curb stops, and other appurtenances in such a manner that there is no interference with the operation of the appurtenances including water and sewer service lines. The tracing wire shall be looped up and left exposed above ground at all meter boxes, valve boxes, and pipe marker signs. Splices of the tracer wire shall be bare wire, twisted and crimped together with a Red 3M Scotchlok and inserted into a 3M DBR Direct Bury Splice Connector. A continuity test shall be performed after installation.

### 3.08 RESTORING TRENCH SURFACE

- A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate the backfill and shall maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.
- B. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.
- C. In sections where the pipeline passes through improved grassed areas (such as lawns), remove and replace the sod (as applicable), or loam and seed the surface in accordance with Section 31\_2900.

### 3.09 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfills, fills, and embankments which may occur during the warranty period (one year) stipulated in the General Conditions.
- B. The Contractor shall refill trenches as often as necessary to bring them back to original grade.
- C. Where settlement occurs in streets, driveways, roads, parking areas, or other paved surfaces, the Contractor shall refill them frequently enough to maintain traffic without hazard at all times.

- D. The Contractor shall make or cause to be made, all repairs or replacements made necessary by the settlement within 7 days after notice by the Engineer or Owner.

END OF SECTION

## SECTION 026600

### DEWATERING AND DRAINAGE

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. Obtain and pay for all permits required for temporary dewatering and drainage. Display and maintain original permits in a prominent location at the site prior to construction of the drainage system.
- B. Furnish the services of a licensed professional engineer, registered in the state in which the project is located, to prepare dewatering and drainage system designs and submittals.
- C. Furnish, install, operate, monitor, maintain and remove temporary dewatering and drainage systems as necessary to lower and maintain groundwater levels below subgrades of excavation to permit construction in-the-dry. Prevent surface water runoff from entering or accumulating in excavation.
- D. Collect and properly dispose of all discharge water from dewatering and drainage systems in accordance with local and State requirements, permits, and any special provisions of Section 013200.
- E. Repair damage caused by dewatering and drainage system operations.
- F. Remove temporary dewatering and drainage systems when no longer needed. Restore all disturbed areas.

##### 1.2 RELATED WORK

- A. Section 311000 – Site Preparation
- B. Section 015713 – Sedimentation and Erosion Control
- C. Section 329219 – Seeding for Site Restoration

##### 1.3 SUBMITTALS

- A. Submit in accordance with Section 013300 all temporary dewatering and drainage system designs. Dewatering and drainage system designs shall be prepared by a licensed professional engineer, registered in the state in which the Work is located, having a minimum of five years of professional experience in the design and construction of dewatering and drainage systems. Submittal will be for information purposes only. Contractor shall retain responsibility for adequacy and safety of construction means, methods and techniques.
- B. In accordance with Section 013300, submit copies of all required permits prior to installing and operating dewatering and drainage systems.

##### 1.4 DEFINITIONS

- A. Where the phrase "in-the-dry" is used in these specifications, it shall be defined as in situ soil moisture content of no more than two (2) percentage points above the optimum moisture content for that soil.

## 1.5 DESIGN AND PERFORMANCE RESPONSIBILITY

- A. The Contractor is responsible for the design and execution of methods for controlling surface water and groundwater.
- B. The Contractor is responsible for repairing damage to properties, buildings or structures, sewers and other utility installations, pavements, and work that may result from dewatering or surface water control operations.
- C. Design review and field monitoring activities by the Owner or the Engineer shall not relieve the Contractor of responsibility for the work.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Pipe for observation wells, if required, shall consist of 1-in. I.D. minimum, Schedule 80 PVC pipe and machine slotted PVC wellpoints, maximum slot size 0.020-in.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Control surface water and groundwater such that excavation to final grade is made in-the-dry and bearing soils are maintained undisturbed. Prevent softening, or instability of, or disturbance to, the subgrade due to water seepage.
- B. Provide protection against flotation for all work.
- C. The impact of anticipated subsurface soil/water conditions shall be considered when selecting methods of excavation and temporary dewatering and drainage systems. Where groundwater levels are above the proposed bottoms of excavations, a pumped dewatering system is expected for predrainage of the soils prior to excavation to final grade and for maintenance of the lowered groundwater level until construction has been completed to such an extent that the foundation, structure, pipe, conduit, or fill will not be floated or otherwise damaged. Type of dewatering system, spacing of dewatering units, and other details of the work are expected to vary with soil/water conditions at a particular location.
- D. At least two (2) weeks prior to the start of construction in any areas of anticipated dewatering, submit to the Engineer for review a proposed plan for removal of water, a method(s) of excavation, and a method(s) of excavation support. Do not proceed with construction in any of these areas until the initial plan has been reviewed and commented upon by the Engineer. It is expected that the initial plan may require modification to suit any variable soil/water conditions encountered on the construction site.

### 3.2 SURFACE WATER CONTROL

- A. Control surface water runoff to prevent flow into excavations. Provide temporary measures such as dikes, ditches and sumps.
- B. Collect precipitation or surface runoff in shallow ditches around the perimeter of the excavation, drain to sump, and pump from the excavation to maintain in-the-dry conditions.

### 3.3 EXCAVATION DEWATERING

- A. Provide and maintain adequate equipment and facilities to remove promptly and dispose of properly all water entering excavations. Excavations shall be kept in-the-dry, so as to maintain all undisturbed subgrade conditions throughout construction below grade, including backfill and fill placement.
- B. Pipe and conduit shall not be installed in water or allowed to be submerged prior to backfilling. Pipe and conduit that becomes submerged shall be removed and the excavation dewatered and restored to proper conditions prior to reinstalling the pipe and conduit.
- C. Excavation for foundations and structures shall be maintained in-the-dry for a minimum of four days after concrete placement. In no event shall water be allowed to enter an excavation and rise to cause unbalanced pressure on foundations and structures until the concrete or mortar has set at least 24 hours.
- D. Dewatering and drainage operations shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade at the bottom of the excavation. If the subgrade becomes disturbed for any reason, the unsuitable subgrade material shall be removed and replaced with concrete, compacted granular fill, or other approved material to restore the bearing capacity of the subgrade to its original undisturbed condition.

#### 3.4 WELL POINT SYSTEM

- A. As part of the dewatering system, a vacuum wellpoint system may be required around the excavation to dewater granular soils. Each wellpoint and riser pipe shall be surrounded by a sand filter. Sand shall be of such a gradation that, after initial development of wellpoints, the quantity and size of soil particles discharged shall be negligible. The wellpoint system shall be capable of operating continuously under the highest possible vacuum.
- B. The installation of the well point system shall be done under the supervision of a qualified representative of the wellpoint equipment supplier.

#### 3.5 DISPOSAL OF DRAINAGE

- A. All water discharged from temporary dewatering and drainage systems shall be disposed of in accordance with the sedimentation and erosion control plans as specified in Section 015713. Existing or new sanitary sewer systems shall not be used to dispose of drainage unless the written permission of the utility or Owner is obtained.
- B. Dispose of drainage to prevent flow or seepage back into excavated areas. Disposal area shall be approved by the Engineer.

#### 3.6 GROUNDWATER OBSERVATION WELLS

- A. Prior to excavating 10-ft. or more below original grade, install one (1) groundwater observation well at the center, or adjacent to each structure under construction for the purpose of measuring water levels during excavation. The observation well shall consist of a screen, casing and cap, all of approved size and materials of construction. Place observation well in a 2-½-in. bore hole, which shall be carried to or below final bottom grade of the structure. Backfill the annular space surrounding the intake point and the riser pipe with mortar sand. Seal the well top to prevent infiltration from surface water. Locate and install the observations well in such a manner as to insure proper reflection of subsurface water levels adjacent to the well.
- B. Maintain the observation well until the adjacent structure is completed and backfilled.

Observe and record daily the groundwater elevation in each observation well. Furnish measurements daily to the Engineer. Redevelop or replace plugged observation wells as necessary to reflect true groundwater levels.

END OF SECTION

## SECTION 31 2330

### GRANULAR MATERIALS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and obtain materials for filling and backfilling, grading and miscellaneous sitework, for the uses shown on the Drawings and as specified herein.

##### 1.02 RELATED WORK

- A. Site Preparation is included in Section 31\_1100.
- D. Earthwork is included in Section 31\_2000.
- E. Trenching, Backfilling and Compaction is included in Section 31\_2300.

##### 1.03 SUBMITTALS

- A. Submit, in accordance with Section 01\_3000, complete product data for materials specified in this Section.

##### 1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 2. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600kN-m/m)).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

##### 1.05 QUALITY ASSURANCE

- A. Laboratory Testing
  - 1. At least 7 days prior to the placement of any backfill or fill materials, deliver a representative sample of the proposed materials weighing at least 50 lbs to the soils testing laboratory.
  - 2. Engage the soils testing laboratory to perform:
    - a. Grain size analyses of the samples to determine their suitability for use as backfill or fill material in conformance to the materials requirements specified herein.
    - b. The appropriate Proctor analyses to determine the maximum dry densities required for compaction testing as specified elsewhere in the Contract Documents.
  - 3. Test results and determinations of suitability shall be delivered to the resident project representative no later than 3 days prior to the placement of backfill or fill materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Backfill and Fill materials shall be suitable excavated materials, natural or processed mineral soils obtained from off-site sources or graded crushed stone or gravel. Backfill and Fill materials shall be free of all organic material, trash, snow, ice, frozen soil, or other objectionable materials which may be compressible or which cannot be properly compacted. Soft, wet, plastic soils which may be expansive, clay soils having a natural, in-place water content in excess of 30 percent, soils containing more than 5 percent (by weight) fibrous organic materials, and soils having a plasticity index greater than 30 shall be considered unsuitable for use as backfill and fill. Backfill and fill materials shall have a maximum of 1 percent expansion when testing is performed on a sample remolded to 95 percent of maximum dry density (per ASTM D1557) at 2 percent below optimum moisture content under a 100 lbs/sq ft surcharge.
- B. Structural Fill shall be clean, crushed stone meeting the requirements of ARDOT Aggregate Base Course Class 7. This shall be used under and extended horizontally 5 feet from all structures.
- C. Selected Common Fill shall conform to the requirements of common fill except that the material shall not contain any materials larger than 2-in in largest dimension.
- D. Common Fill shall not contain granite blocks, broken concrete, masonry rubble, asphalt pavement, or any material larger than 6-in in any dimension. Common Fill shall have a plasticity index of less than 15 and shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer By Weight</u>
No. 40	75
No. 200	20

- E. Crushed Stone shall be sound, durable stone, angular in shape, and free of any foreign material, structural defects and chemical decay. Crushed stone shall be locally available gravel screenings.
- F. Pea Gravel shall be screened, uniformly rounded stone, free from sand, loam, clay, excess fines and other deleterious materials. Pea Gravel shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer By Weight</u>
1/2-in	100
3/8-in	90
No. 4	30
No. 8	10
No. 16	5

- H. Sand for concrete, grout, and masonry shall conform to ASTM C33 for fine aggregate. General purpose sand shall be Select Common Fill.
- I. Flowable Fill shall be ready-mix, cast-in-place concrete conforming to the requirements of Division 3 Specifications and meeting the mix requirements in Part L below.
- J. Filter fabric shall be Mirafi, Type 140N; Dupont, Type PAR, Style 3401, or equal product by Amoco and shall conform to the following requirements:



1. Minimum grab strength of 120 lbs per ASTM D1682.
  2. Equivalent open size (EOS) to be equal to or greater than the U.S. Standard Sieve No. 100 (0.210 mm) per ASTM D442.
  3. Percent open area not to exceed about 25 percent. The percent open area is defined as the ratio of the sum of 20 or more individual open areas (times 100) to the sum of the corresponding 20 or more individual total areas.
  4. Coefficient of permeability shall not be less than 10-2 cm/sec.
- K. Impermeable Fill shall conform to the requirements of the Unified Soil Classification System for soil types CL, CH, or OH per ASTM D2487 and shall have a coefficient of permeability of  $1 \times 10^{-7}$  cm/sec or less after compaction.
- L. Flowable Fill used as backfill and fill shall be comprised of a mixture of Portland cement, coarse aggregate, fine aggregate and water. Materials, methods of preparation, and placement techniques shall comply with the requirements of Section 03\_3300 as for concrete. Design mix shall result in a flowable material with a 28 day compressive strength of approximately 60 psi. Recommended mix shall be as follows:
- |                  |      |                         |
|------------------|------|-------------------------|
| Portland Cement  | 40   | lbs/cu yd               |
| Coarse Aggregate | 1700 | lbs/cu yd               |
| Fine Aggregate   | 1900 | lbs/cu yd               |
| Water            | 325  | lbs/cu yd, or as needed |
- M. Low Density Cellular Concrete Fill shall conform to the requirements of Specification Section 03\_3400 of these contract documents.

PART 3 EXECUTION (NOT USED)

END OF SECTION



SECTION 31 2500

SWPPP AND EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Arkansas Department of Environmental Quality has promulgated the Construction General Permit (CGP) which authorizes stormwater discharges from large and small construction activities that result in a total land disturbance of equal to or greater than one acre, where those discharges enter surface waters of the State or a municipal separate storm sewer system (MS4) leading to surface waters of the State subject to the conditions set forth in the permit. This permit also authorizes stormwater discharges from any other construction activity designated by ADEQ where ADEQ makes that designation based on the potential for contribution to an excursion of a water quality standard or for significant contribution of pollutants to waters of the State.
- B. The CONTRACTOR is responsible for obtaining coverage under the Construction General Permit or other individual permit, if applicable. Automatic coverage and waivers are available for small construction sites for which submittal of a NOI, SWPPP and fee are not required. The CONTRACTOR shall prepare and post the Notice of Coverage (NOC) and the Stormwater Pollution Prevention Plan (SWPPP) as required by the Construction General Permit for sites less than 5 acres. The CONTRACTOR should make sure to read and understand the conditions of the permit. A copy of the General Stormwater Construction Permit is available on the ADEQ web site at [www.adeq.state.ar.us/water/branch\\_permits/general\\_permits/stormwater/](http://www.adeq.state.ar.us/water/branch_permits/general_permits/stormwater/). You may also obtain a hard copy by contacting the ADEQ's General Permits Section at (501) 682-0623
- C. If the site is larger than 5 acres, the CONTRACTOR SHALL OBTAIN COVERAGE IN THE UTILITY'S NAME and submit a Notice of Intent (NOI), a stormwater pollution prevention plan (SWPPP), and pertinent fees and other requirements set forth in the CGP.

1.02 QUALITY ASSURANCE

- A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION



SECTION 31 2900

TOPSOIL AND SEEDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and place topsoil, finish grade, apply lime and fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Drawings and as specified herein, including all areas disturbed and all existing lawn areas.

1.02 RELATED WORK

- A. Site Preparation is included in Section 31\_1100.
- B. Earthwork is included in Section 31\_2000.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete shop drawings, materials and equipment furnished under this Section including seed mixtures and product label information.
- B. Samples of all materials shall be submitted for inspection and acceptance upon Engineer's request.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be fertile, natural sandy loam soil, free from large stones, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Topsoil stockpiled under other Sections of this Division may be used, but the CONTRACTOR shall furnish additional loam at his/her own expense if required.
- B. Fertilizer shall be a complete commercial fertilizer, 10-10-10 grade for grass areas. It shall be delivered to the site in the original unopened containers each showing the manufacturer's guaranteed analysis. Store fertilizer so that when used it shall be dry and free flowing.
- C. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates.
- D. Grass seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85 and shall have not more than 1 percent weed content. The mixture shall consist of that specified in Section 620, AHTD Standard Specifications for Highway Construction.
- E. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the certificates have been submitted.
- F. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and

agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

### PART 3 EXECUTION

#### 3.01 APPLICATION

- A. Unless otherwise shown on the Drawings, loam shall be placed to a minimum depth of 4-in. in all areas.
- B. For all areas to be seeded:
  - 1. Lime shall be applied at the rate of 25 lbs/1,000 sq ft.
  - 2. Fertilizer (10-10-10) shall be applied at the rate of 30 lbs/1,000 sq ft.
  - 3. Lawn grass seed shall be applied at the rate of 10 lbs/1,000 sq ft.
  - 4. Fiber mulch shall be applied at the rate of 20 lbs/1,000 sq ft.
- C. The application of fertilizer and lime may be performed hydraulically in one operation with hydroseeding and mulching. If lime is applied in this manner, clean all structures and paved areas of unwanted deposits.

#### 3.02 INSTALLATION

- A. The subgrade of all areas to be loamed and seeded shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam. Subgrade shall be inspected and approved by the Engineer before loam is placed.
- B. Loam shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.
- C. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign material shall be removed from the loamed area and disposed of. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs/ft of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.
- D. Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the Engineer. Hydroseed only on a calm day.
- E. Schedules for seeding and fertilizing must be submitted to the Engineer for approval prior to the work.
- F. If lime and fertilizer are to be spread mechanically rather than in one operation with the hydroseeding, then:
  - 1. After the loam is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over loam surface and thoroughly incorporated with loam by heavy raking to

at least 1/2 the depth of loam.

2. Fertilizer shall be uniformly spread and immediately mixed with the upper 2-in of topsoil.
- G. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Hydroseeder.
- H. In order to prevent unnecessary erosion of newly graded slopes and unnecessary siltation of drainage ways, carry out seeding and mulching as soon as satisfactory completion of a unit or portion of the project. A unit of the work will be defined as not more than 20,000 sq ft.
- I. When protection of newly graded areas is necessary at a time that is outside of the normal seeding season, protect those areas by whatever means necessary (such as straw applied with a tar tack) or by other measures as approved by the Engineer.

### 3.03 SEEDING IN WOODED AND UNGRADED AREAS

- A. For preparation and seeding in wooded areas under this Contract and where no grading is required, all of the specified materials and procedures shall be utilized except that no disking shall be performed within the drip line of trees to be preserved. The seed bed shall be prepared by the addition of a thin layer of top soil roughly 1-in deep.

### 3.04 MAINTENANCE AND PROVISIONAL ACCEPTANCE

- A. Keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and shall maintain these areas in an approved condition including a minimum of two mowings of the lawn areas until provisional acceptance.
- B. On slopes, provide against washouts by an approved method. Any washout that occurs shall be regraded and reseeded at the CONTRACTOR's expense until a good sod is established.
- C. The Engineer will inspect all work for provisional acceptance at the end of the 8 week grass maintenance period, upon the written request, received at least 10 days before the anticipated date of inspection.
- D. A satisfactory stand will be defined as a section of grass of 100 sq ft or larger that has:
  1. No bare spots larger than 2 sq ft.
  2. No more than 10 percent of total area with bare spots larger than 1 sq ft.
  3. Not more than 15 percent of total area with bare spots larger than 6-in square.
- E. Furnish full and complete written instructions for maintenance of the lawns to the UTILITY at the time of provisional acceptance.
- F. The inspection by the Engineer will determine whether maintenance shall continue in any area of manner.
- G. After all necessary corrective work and clean-up has been completed and maintenance instructions have been received by the UTILITY, the Engineer will certify in writing the

provisional acceptance of the lawn areas. Maintenance of lawns or parts of lawns shall cease on receipt of provisional acceptance.

3.05 GUARANTEE PERIOD AND FINAL ACCEPTANCE

- A. All seeded areas shall be guaranteed for not less than 1 full year from the time of provisional acceptance.
- B. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Lawn areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.
- C. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the lawns.

END OF SECTION



SECTION 025110  
GRAVEL SURFACING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Repairing existing gravel surfaces disturbed during construction, and gravel surfacing at the pump station site and as indicated on the Drawings.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):

- 1. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

- B. Arkansas Department of Transportation

- 1. Aggregate Base.

1.3 TESTS

- A. Gradation of stone materials will be performed in accordance with ASTM C136.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Gravel:

- 1. Crushed or uncrushed stone.

- 2. Free from objectionable, deleterious, or other injurious matter.

- 3. Graded to ADOT standards, Type A or C.

PART 3 - EXECUTION

3.1 PLACING GRAVEL

- A. For compacted depths exceeding 8 inches, place material in multiple courses of equal depth which do not exceed 8 inches. Gravel surface shall be a minimum of 8-inches thick.

- B. Compact each course with mechanical compaction equipment approved by the Engineer. Compaction with wheel of backhoe or track of trackhoe is not acceptable. Compact to 95 percent of maximum density at optimum moisture content as determined by ASTM D698 Standard Proctor Density.

- C. Finish grade to provide smooth transition with surrounding gravel. Avoid leaving any humps or ruts.

- E. Repair settling as required.

END OF SECTION

## SECTION 323113

### CHAIN LINK FENCES AND GATES

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Chain Link Fencing.
- B. Chain Link Fence Swing Gates.

##### 1.2 SCHEDULE

- A. Chain link fencing shall be constructed as shown on the Drawings as follows:
  - 1. Pump Station Site: Black PVC-coated chain link fencing system as specified herein.

##### 1.3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM B117 - Test Method of Salt Spray (Fog) Testing.
- C. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- D. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- E. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- F. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- G. ASTM F567 - Practice for Installation of Chain-Link Fence.
- H. ASTM F669 - Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fences.
- I. ASTM F1083 - Pipe, Steel, Hot-Dipped, Zinc-Coated (Galvanized), Welded, for Fence Structures.
- J. ASTM F1043 - Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.

##### 1.4 SUBMITTALS

- A. Procedures for Submittals: Section 013300.
- B. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- C. Product data: Manufacturer=s catalog cuts indicating material compliance and specified options.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer: Provide chain link fencing and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings.
- B. Erector Qualifications: Minimum of two (2) years' experience installing similar fencing.

## 1.6 COORDINATION

- A. Details of fence material and construction in this specification take precedence over those shown. General arrangement of fence shall be as shown.

## 1.7 MANUFACTURER

- A. The chain link fence manufacturer must have a minimum of five (5) years' experience manufacturing galvanized coated chain link fencing
- B. Chain link fences and gates, including accessories, fittings, and fastenings must be obtained from a single source.

## **PART 2 - PRODUCTS**

### 2.1 CHAIN LINK FENCE FABRIC

- A. Galvanized wire: ASTM A392 Standard Specification for Zinc Coated Steel Chain Link Fence Fabric.
- B. Chain link fence shall be made of steel wire helically wound and interwoven in such a manner as to provide a continuous mesh without knots or ties except in the form of knuckling or twisting the ends of the wire to form the desired selvage of the fabric.
- C. Zinc coating: 2.0 ounce per square foot.
- D. Fabric height: 6 feet
- E. Coated wire: 9 gauge.
- F. Mesh size: 2 inches.
- G. PVC-coated fabric: 10-mil heavy mil thickness PVC coating, extruded and adhered to zinc coated wire per Class 2a of ASTM F668. Color: black.

### 2.2 GALVANIZED FRAMEWORK

- A. The following types of steel frame members are allowed:
  - 1. Steel pipe - Type I: ASTM F 1083, standard weight schedule 40; minimum yield strength of 30,000 psi, hot-dipped galvanized with minimum average 1.8 oz/ft<sup>2</sup> of coated surface area.
  - 2. Steel pipe - Type II: LG 40 Cold formed and welded steel pipe complying with ASTM F 1043, Group IC, with minimum yield strength of 50,000 psi. Protective coating per ASTM F 1043, 0.9 oz/ft<sup>2</sup> minimum zinc coating. Internal coating Type B, minimum 0.9 oz/ft<sup>2</sup> zinc.

- B. Frame Size:
  - 1. End and corner post: 3-inch O.D.
  - 2. Line post: 2-1/2-inch O.D.
  - 3. Rail and braces: 1-5/8-inch O.D.
  - 4. Gate posts: 4-inch O.D.
- C. Provide rails with outside sleeve-type expansion couplings which provide rigid attachment and allow for anticipated movement.
- D. Interrupt rails only at posts.
- E. Continuous top and bottom rails are required. Middle rails only at junction between corner/terminal posts and adjacent line posts.
- F. PVC-coated finish: In accordance with ASTM F1043, apply supplemental color coating of 10 to 15 mils in black color to match fabric.

### 2.3 SWING GATES

- A. Swing gates shall be installed as shown on the Drawings.
- B. Gate Frames: Gates to be fabricated in accordance with ASTM F 900 using galvanized steel members 1.90-inch O.D. weighing 2.28 lb/ft, welded at all corners. Welded joints coated, employing a zinc-rich paint.
- C. Chain link fabric filler shall match that shown in the fence section. Fabric to be attached to frame by means of tension on fabric bands at the external vertical members and attached by means of tie wires to all horizontal and any internal vertical members. These bands and ties to be a maximum of 15-inch centers. The fabric shall be attached to the bands using a fabric or tension bar.
- D. Swing gates shall be furnished complete with pressed steel corner fittings, pivot-type hinges, locking catch for padlock, drop rod, and Ahold open@ latching device to secure gates.
- E. The gates shall be topped with 3 strands of barbed wire.
- F. PVC-coated finish: All components of swing gate shall be black coated to match PVC-coated fencing as specified herein.

### 2.4 ACCESSORIES

- A. Chain link fence accessories: Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing. All nuts and bolts to be galvanized.
- B. Post caps: Pressed steel. Provide one cap for each post. Caps must be weatherproof to prevent moisture intrusion into post.
- C. Top rail and brace rail ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts.
- D. Top rail sleeves: 6-inch pressed steel.
- E. Wire ties: 9 gauge galvanized steel wire for attachment of fabric to line posts. Double

wrap 13 gauge for rails and braces. Hog ring ties of 9 gauge for attachment of fabric to tension wire.

- F. Tension (stretcher) bars made of one continuous piece of steel, 3/16-inch x 3/4-inch. Provide one bar per end or gate post and two bars per corner or pull post.
- G. Tension wire: Galvanized coated steel wire, 7 gauge diameter wire with tensile strength of 75,000 psi.
- H. Truss rods and tightener: 3/8-inch diameter.
- I. Tension Band: 1/8-inch x 1-inch.
- J. Brace Band: 1/8-inch x 1-inch.
- K. Barbed wire: Galvanized coated, per ASTM A-121 Type Z - Class 3 with .80oz/sf zinc coated wire, double strand, 12-1/2 gauge, twisted line wire with, 4 point barbs, spaced approximately 5-inches on center.
- L. Barbed wire supporting arms: Pressed steel arms with provisions for attaching 3 rows of barbed wire. Arms shall withstand 250 lb. downward pull at outermost end of arm without failure.
- M. PVC-coated finish: All fencing accessories shall be black coated to match PVC-coated fencing as specified herein.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Verify suitability of areas to accept installation.
- B. Verify location of underground utilities before starting installation.
- C. Installation constitutes Contractor acceptance of conditions and responsibility for performance.

#### **3.2 CHAIN LINK FENCE FRAMING INSTALLATION**

- A. Install chain link fence in accordance with ASTM F567 and manufacturer=s instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30E or more.
- C. Space line posts uniformly at 10 feet on center maximum.
- D. Concrete set posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter 4 times greater than the outside dimension of the post, and depths approximately 6-inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36-inches below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post. Slope to direct water away from posts.
- E. Set posts in Class A concrete.

- F. Plumb posts to 1/4 inch in 10 feet. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- G. Bracing: Install horizontal pipe brace at mid-height on each side of terminal or corner posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- H. Install bracing assemblies at end and gate posts and at both sides of corner and pull posts.
  - 1. Locate compression members at mid-height of fabric.
  - 2. Extend diagonal tension members from compression members to bases of posts.
  - 3. Install so that posts are plumb when under correct tension.

### 3.3 CHAIN LINK FABRIC INSTALLATION

- A. Fabric: Install fabric on security side and attach so that fabric remains in tension after pulling force is released. Leave approximately 2 inches between finish grade and bottom selvage. Attach fabric with wire ties to line posts at 15 inches on center and to rails, braces, and tension wire at 24 inches on center. A tension wire shall be installed at the bottom selvage of all fabric.
- B. Tension bars: Pull fabric taught; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15 inches on center.

### 3.4 ACCESSORIES

- A. Tie wires: bend ends of wire to minimize hazard to persons and clothing.
- B. Fasteners: Install nuts on side of fence opposite fabric side for added security.

END OF SECTION





## SECTION 33 0501

### PIPELINE TESTING AND CLEANING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and test and clean all new pipelines installed under this Contract as specified herein.

##### 1.02 RELATED WORK

- A. Buried pipelines are included in Division 33.
- B. Above grade and exposed pipelines are included in Division 40.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION

##### 3.01 GENERAL

- A. Furnish all necessary equipment and labor for cleaning, and testing the pipelines. The disinfection of pipelines shall follow procedures specified in Section 33 1300. The procedures and methods for cleaning and testing shall be approved by the Engineer.
- B. Make any taps and furnish all necessary caps, plugs, etc, as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

##### 3.02 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

##### 3.03 TESTING NON-PRESSURE GRAVITY PIPELINES

- A. All gravity pipelines shall be tested for leakage by an infiltration or exfiltration test. Buried piping shall be tested by an infiltration test if the groundwater is more than 2-ft above the crown of the pipe for the full length of the section to be tested. Air testing may be used in lieu of an exfiltration test subject to approval of the Engineer.
- B. Exfiltration Test
  - 1. Leakage tests by exfiltration shall be made by creating a head in the pipeline to be tested by filling the line and either a manhole or temporary riser on one end of the line with water. The length of pipe to be tested shall be such that the head over the crown at the upstream end is not less than 2-ft and the head over the downstream crown is not more than 6-ft. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of

at least one hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.

2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be removed and replaced. If the quantity of water required to maintain a constant head in the pipe does not exceed 1.9 gallons per inch of diameter per day per 100-ft of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory.

C. Infiltration Test

1. Pipe shall be tested for infiltration after the backfill has been placed and the ground water allowed to return to normal elevation. The length of line to be tested shall be not less than the length between adjacent manholes and not more than the total length of each size of pipe. The allowable infiltration shall be 1.9 gallons per inch of diameter per day per 100-ft of pipe in each section tested. There shall be no gushing or spurting leaks.
2. If an inspection of the completed pipeline or any part thereof shows pipes or joints which allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed.
3. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe installed in an approved manner and at such times and locations as may be directed by the Engineer.

- D. When the pipeline to be tested is reinforced concrete pipe, the allowable leakage in the above tests shall be 4.7 gallons per inch of diameter per 100-ft of pipe.

E. Low Pressure Air Test

1. Low-pressure air tests shall be made with equipment specifically designed and manufactured for the purpose of testing pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. All air used shall pass through a single control panel.
2. Install plugs at manholes. Brace plugs securely as required for safety and allow no one in the manholes while pressurizing the line or during the test.
3. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig. The internal air pressure in the sealed line shall not be allowed to exceed 8 psig. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig shall not be less than that shown in Table 1 below.

Table 1 – Minimum Specified Time Required for a 1.0 psig Pressure drop for Size and Length of Pipe Indicated

Pipe Diameter (in)	Minimum Time, min:s	Length for Minimum Time, ft	Time for longer lengths, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31

Table 2 – Minimum Specified Time Required for a 0.5 psig Pressure drop for Size and Length of Pipe Indicated

Pipe Diameter (in)	Minimum Time, min:s	Length for Minimum Time, ft	Time for longer lengths, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
6	2:50	398	0.427	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16

4. If the pipe section does not pass the air test (time of air pressure drop is lower than the minimum time require in the table above), sectionalize the section tested to determine the location of the leak. Once the leak has been located, repair and retest.

### 3.04 TESTING PRESSURE PIPELINES

- A. All pressure pipelines shall be pressure and leakage tested. Pipelines shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure and this pressure maintained for at least 10 minutes. The leakage test shall be conducted at the maximum operating pressure as determined by the Engineer, and this pressure shall be maintained for at least two hours. The test pump and water supply shall be arranged to allow accurate measurement of the water required to maintain the test pressure to within 5 psi of the test pressure setpoint. Where applicable, hydrant branch gate valves shall remain open during this test. The amount of leakage which will be permitted shall be in accordance with AWWA C600 as shown below:

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

Where: L = makeup water in gallons per hour  
 S = length of pipe tested in feet  
 D = nominal pipe diameter in inches  
 P = average test pressure in psi

END OF SECTION



## SECTION 33 1101

### DUCTILE IRON PRESSURE PIPE AND FITTINGS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, install, and test ductile iron water pipe and fittings for piping as shown on the Drawings and as specified herein. This specification also governs the ductile iron pipe used for Wastewater and sludge forcemain applications.
- B. Piping shall include all piping and fittings extending outward, upward and downward into the ground from the outside face of all buildings. Piping shall begin at the outside face of the buildings. The first joint shall be not more than 2-ft from the outside face of the building or structure unless otherwise shown on the Drawings. Piping shall include all piping in valve vaults, manholes, cleanouts and similar yard structures.
- C. Piping shall be located substantially as shown on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the CONTRACTOR's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

##### 1.02 RELATED WORK

- A. Trenching, Backfilling and Compaction is included in Section 31\_2300.
- B. Valves, Hydrants and Appurtenances are included in Section 33\_1200.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data, including piping layouts, design calculations, warranty information, test reports, in accordance with Section 01\_3000 and the referenced standards.
- B. Submit design calculations in accordance with Paragraph 2.02 below signed by a Professional Engineer, as noted in Section 01300.
- C. Submit the name of the pipe and fitting suppliers and a list of materials to be furnished.
- D. Prior to shipment of pipe, certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards, shall be submitted.
- E. Submit copies of all shop tests, including hydrostatic tests.
- F. Submit information on all warranties per Section 01\_7836.
- G. Submit shop drawings with a tabulated laying schedule which references stations and invert elevations as shown on the Drawings as well as all fittings, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items. The laying schedule shall

show pipe class, class coding, station limits and transition stations for various pipe classes. The above shall be submitted to the Engineer for approval before manufacture and shipment. The location of all pipes shall conform to the locations indicated on the Drawings. Full length pipe may be supplied from inventory provided that all specification requirements are met. Shop drawings shall include but not be limited to:

1. Complete and dimensional working drawings of all pipe layouts, including pipe stationing, invert elevation at changes in grade or horizontal alignment, all elements of curves and bends both in horizontal alignment and vertical position.
  2. The grade of material; size, wall thickness, of the pipe and fittings and appurtenances, type and location of fittings, specials, and valves; and the type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings. Methods and procedures recommended by the coating manufacturer will be documented.
  3. Joint details; methods and locations of supports; and complete information concerning type, size and location of all welds. Shop welds (no field welding will be allowed) will be clearly differentiated and welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details will also be clearly identified.
  4. Method of manufacture of pipe; joint details; fittings; and any specials.
  5. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.
- H. Submit anticipated production and delivery schedule.
- I. Prior to shipment of pipe, submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- J. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.
- 1.04 REFERENCE STANDARDS
- A. American Society for Testing and Materials (ASTM)
1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
  2. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
  3. ASTM A242 – Standard Specification for High-Strength Low-Allow Structural Steel
  4. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  5. ASTM A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
  6. ASTM C150 - Standard Specification for Portland Cement.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in (75mm Through 1219mm) for Water.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.
7. AWWA C115 – Flanged Ductile Iron Pipe With Ductile Iron or Grey Iron Threaded Flanges.
8. AWWA C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
9. AWWA C153 - Ductile- Iron Compact Fittings, 3-in through 24-in and 54-in through 64-in, for Water.
10. AWWA C550 – Protective Interior Coatings for Valves and Hydrants
11. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
12. AWWA C606 - Grooved and Shouldered Joints.
13. AWWA C651 - Disinfecting Water Mains.
14. AWWA M41 – Ductile Iron Pipe and Fittings Manual of Water Supply Practices

C. National Sanitation Foundation (NSF)

1. NSF 61 – Drinking Water System Components Health Effects.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. It is a requirement of these Contract Documents to have all of the ductile iron pipe under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. Similarly. It is a requirement of these Contract Documents to have all of the ductile iron fittings under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. All connections between the pipe and fittings shall be compatible, as detailed in Section 1.06.
- B. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any leak or rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

- D. All ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results at least 5 days prior to the shipment of the goods.
- E. Inspection of the pipe and fittings will also be made by the Engineer or representative of the UTILITY after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements even though pipe may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery (including defects from manufacturing or delivery/transport) shall be marked for identification and shall immediately be removed from the job at the Contractors expense.
- F. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the UTILITY at the UTILITY's expense.
- G. A manufacturer's representative shall be made available to the UTILITY and UTILITY's representative during the manufacturing furnishing, transporting, and unloading of the pipe during installation and testing of the pipe to assist in insuring that the pipe is properly fabricated, transported, unloaded, stored in the field, joined and tested. Manufacturer's responsibilities relate only to the proper care and treatment of the pipe during these procedures and not the techniques or procedures used during installation and testing.
1. The designated factory representative shall be made available at any time the UTILITY may request. The field or site representative shall be made available a minimum of [2] working days (time on site) during the project when requested by the UTILITY.
  2. The cost for the services of the factory representative, including expenses, shall be considered incidental to the project and will not be paid separately.
- H. The manufacturer shall meet the following criteria and furnish the necessary project information , which demonstrates the required experience:
1. Experience that includes successful fabrication (followed by installation, acceptance and service) to AWWA C151 standards of at least [50,000] lineal feet of the largest specified diameter or larger ductile iron pipe with similar linings/coatings within the past 5 years.
  2. Experience shall include the successful fabrication of at least 50- fittings in compliance with AWWA C110 or C153 of the largest specified diameter or larger with similar lining/coatings within the past 5 years.
  3. Experience that includes the successful fabrication (followed by installation, acceptance and service) of at least 10,000 lineal feet of the largest specified diameter or larger push-on style, boltless restrained joint for ductile iron pipe within the last 5 years.
- I. All pipe and fittings shall be marked in accordance with all applicable AWWA standards. Legibly and permanently mark all pipe, fittings, specials and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:
1. Manufacturer, date.
  2. Size, type, class, or wall thickness.
  3. AWWA Standard(s) produced to.



4. Each pipe shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation.
5. Special fittings, bends, and appurtenances requiring specific orientation will be appropriately marked with the words "TOP" in the correct position and in a consistent location.

#### 1.06 DESCRIPTION OF SYSTEMS

- A. Pipe and fittings shall be made in the United States. Pipe and fittings shall be as supplied by the American Cast Iron Pipe Co., U.S. Pipe and Foundry, Griffin Pipe Products, all pipe divisions of the McWane Company, or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA). All ductile iron pipe shall be supplied by a single manufacturer and all ductile iron fittings shall be supplied by a single manufacturer. The fittings supplier shall certify in writing that their fittings are compatible with the supplied brand of pipe.
- B. Pipe is to be installed in those locations shown on the Drawings, and only where specifically indicated.
- C. CONTRACTOR is responsible for compatibility between joints of all items they supply.
- D. In the case of conflict between information on the pipe schedule, Drawings, and or this section especially concerning pressures, coatings, linings minimum thickness etc. the information given in the pipe schedule shall govern.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, pipe linings and pipe coatings. See AWWA C600 and the referenced AWWA Standards for Shipping, handling and storage procedures. All pipe and fittings shall be examined as noted in Division 1. Any damage to linings or coatings discovered during the examination shall be repaired to the satisfaction of the Engineer at the cost of the CONTRACTOR, before proceeding with the work.
- B. Pipe shall be transported to the job site on padded bunks or oak timbers and secured with steel banding or nylon tie down straps to adequately protect the pipe and coating. Slings, hooks, or pipe tongs or other devices acceptable to the Engineer shall be used in pipe handling. No uncushioned ropes, chairs, wedges, cables or levers shall be used in handling finished pipe, fittings or couplings. Under no circumstances shall the pipe or fittings be dropped or skidded against each other. Care shall be taken to preventing marring the pipe coating. Padded wooden pipe cradles, or chocks suitable for the protection of coatings shall be used between finished pipes and beneath them when pipes are placed upon rough surfaces. Pipe shall not be stored on bare ground unless soft sand berms are used to support the pipe and is approved by the Engineer.
- C. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.
- D. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.
- E. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

- F. Lined and/or coated pipe shall be suitably protected from exposure and heating of the sun at all times following procedures recommended by the coating/lining system manufacturer. Exposure will not be allowed (except for short periods such as installation, assembly and repairs).
- G. No metal tools or heavy objects shall be permitted to come in contact unnecessarily with the finished coating. Workers will be permitted to walk upon the coated pipe only when necessary, in which case they shall wear footwear with rubber or composition soles and heels that are sufficiently free of dirt and mud that coating remains undamaged.
- H. It shall be the responsibility of the CONTRACTOR to prevent damage to the linings and coatings that might be caused by handling and/or onsite storage of the finished pipe at low temperatures (due to embrittlement), high temperatures or direct sunlight.

1.08 Warranties

- A. Provide warranties as required in Section 017836

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Ductile iron pipe shall conform to AWWA C151 or ASTM A746. Pipe shall be supplied in standard lengths as much as possible.
- B. Thickness design shall be per AWWA C150. The pipe supplier shall perform thickness analysis as referenced in Paragraph 2.02. All ductile iron pipe supplied shall meet the minimum wall thickness and pressure class indicated on the drawings.

### 2.02 DUCTILE IRON PIPE DESIGN

- A. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with minimum yield strength of 42,000 psi (per AWWA M-41). Design shall be done for external and internal pressures separately using the larger of the two for the net design thickness. Additional allowances shall be made for service allowance and casting tolerance per AWWA C150. The pipe classes determined for various sizes and conditions shall provide the total calculated thickness at a minimum or conform to minimum pipe class specified in Paragraph 2.01 B above, or as shown on the Drawings, whichever is greater.
- B. Design for the net thickness for external loading shall be taken as the greater of the following conditions:
  - 1. 2.5-ft of cover with AASHTO H-20 wheel loads, with an impact factor of 1.5.
  - 2. Depth from existing ground level of future proposed grade (whichever is greater) to top of pipe as shown on the Drawings, with truck load.
  - 3. Soil Density: 125 lbs/cu ft
  - 4. Laying Conditions; AWWA C150, Type 2.
- C. Design for the net thickness shall be based upon the following internal pressure conditions:
  - 1. Design pressure: 350 psi
  - 2. Surge allowance: 100 psi
  - 3. Safety factor: 2
  - 4. Total internal pressure design:  $2(350 + 100) = 900$  psi
  - 5. E': 300 psi
- D. Copies of design calculations showing that the pipe meets all of the requirements specified herein shall be furnished to the Engineer for approval during shop drawing review in accordance with Section 01\_3000. Yield strength of 42,000 psi shall be used during design calculations.

### 2.03 END TREATMENTS/JOINTS

- A. Ductile iron pipe joints shall be push-on rubber gasket type or rubber-gasket mechanical joint per AWWA C111, except where flanged joints are required as shown on the drawings. All gasket

materials shall comply with Table 5-1 of AWWA M-41. Rubber-gasket joints shall conform to AWWA C111. Gasket shall be of styrene butadiene rubber (SBR).

- B. Unless otherwise noted, all buried ductile iron pipe fitting joints shall be rubber-gasket push-on-joint. Where shown on plans the push-on-joint shall utilize a locking restrained gasket for the number of pipe joints shown. *Contractor may substitute push-on-joint pipe with mechanical joint pipe and may substitute locking restrained gaskets, where required, with Megalug Series 1100 restrained glands.*
- C. Unless otherwise noted, all exposed ductile iron pipe fitting joints shall be flanged joint per AWWA C110/C153.
- D. Threaded ductile iron flanges for ductile iron pipe shall be fabricated per AWWA C115 and sealed during installation with a special high pressure, full face gasket per AWWA C111. At the pipe manufacturer's option, the use of 250 lb pattern flanges, which are faced and drilled in accordance with ANSI B16.1 may be substituted in order to match valves or other equipment and/or to meet the required working pressure requirements. All flanges shall be rated for the same pressure as the adjacent pipe in all cases. Compatibility of the flanges with the 250 lb class and higher special class AWWA valves will be the responsibility of the CONTRACTOR.
  - 1. Flanges shall be pre drilled and then faced after being screwed onto the pipe, with flanges true to 90 degrees of the pipe axis and shall be flush with the end of the pipe.
  - 2. Gaskets shall be full face rubber, 1/8" thick SBR material, such as American Toruseal Gasket, or approved equal. Special material ring gaskets such as those by Garlock or equal may be required for pressures exceeding 250 for ANSI rated and custom flanges.
  - 3. **Flanged joints shall be supplied with bolts and nuts on one end, bolt studs with a nut at each end, or studs with nuts on one end where the flange is tapped. The number and size of bolts shall comply with the same standard as the flange. Bolts and nuts for exposed flanged connections shall be Xylan coated.**
  - 4. Blind flanges shall mate with regular flanges.
  - 5. Filler flanges and beveled flange fillers shall be furnished faced and drilled complete with extra length bolts.
- E. Couplings and Adapters
  - 1. Sleeve type couplings shall be HyMax2 Mueller Water Products, or equal.

## 2.04 FITTINGS

- A. Pipe fittings shall be ductile iron with pressure rating of 350 psi. Fittings shall meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe, unless shown otherwise.
- B. Closures shall be made with mechanical joint ductile iron solid sleeves, restrained with follower glands on each end, unless alternate approved coupling systems as described in paragraph 2.03E are used and shall be located in straight runs of pipe at minimum cover outside the limits of restrained joint sections. Location of closures shall be subject to approval of the Engineer.
- C. Unless otherwise noted, all buried ductile iron pipe fitting joints shall be rubber-gasket mechanical joint per AWWA C111 and shall be restrained with a Megalug Series 1100 retaining gland at each side.
- D. Unless otherwise noted, all exposed ductile iron pipe fitting joints shall be flanged joint per AWWA C110/C153.

## 2.05 INTERIOR LINING

- A. Ductile iron pipe and fittings shall have cement mortar lining.

## 2.06 EXTERIOR COATING

- A. Buried pipe and fittings shall be installed with a bituminous coating in accordance with AWWA C151 and C110 respectively.
- B. Buried pipe and fittings shall be installed with polyethylene encasement. Polyethylene encasement shall have a minimum thickness of 8 mils and meet or exceed the minimum standards established by AWWA C105, current edition.
  - 1. Polyethylene encasement shall meet minimum size requirements per TABLE 3 of section 2.15 of DIPRA's Installation Guide For Ductile Iron Pipe.
  - 2. Test results from an independent testing agency certifying that the polyethylene encasement meets all criteria established by AWWA C105, current edition, shall be submitted to the Engineer prior to approval of the polyethylene encasement for use. In general, samples shall be submitted and include test results in accordance with the AWWA standard associated with tensile strength, elongation, dielectric strength, impact resistance, and propagation tear resistance.
  - 3. A 2-inch wide plastic adhesive tape, such as Denso Utility Wrap, Calpico Vinyl, Polyken 900, or equal, shall be used for sealing seams, cuts, or tears in polyethylene encasement. Duct tape shall not be allowed.
- C. Exposed pipe and fittings shall be installed with an epoxy primer coating (shop primed) as specified for field top-coat in Section 099100, or equal, or supplied as uncoated pipe and field primed and painted in accordance with Section 099100.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe and fittings shall not be dropped or skidded against each other. Slings, hooks or pipe tongs shall be used for pipe handling. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe, lining or coatings shall be repaired per manufacturer's recommendations. Handling and laying of pipe and fittings shall be in accordance with manufacturer's instruction and as specified herein.

If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.

- B. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.

- D. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

### 3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe shall be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the Drawings. Blocking will not be permitted. If any defective pipe or fitting is discovered after it has been laid, it shall be removed and replaced with a sound pipe or fitting in a satisfactory manner by the CONTRACTOR, at his/her own expense.

All pipe and fittings shall be kept clean until they are used in the work and shall be sound and thoroughly cleaned before laying. When laid, the pipe and fittings shall perform to the lines and grades required. When laying is not in progress, including lunch breaks, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed that recommended by the manufacturer.

All ductile iron pipe laid underground shall have a minimum of 3 of feet of cover unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid such that the invert elevations shown on the Drawings are not exceeded.

Fittings, in addition to those shown on the Drawings shall be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Engineer.

The pipe interior shall be maintained dry and broom clean throughout the construction period.

When field cutting the pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The end of the cut pipe shall be beveled to conform to the manufacture's recommendations for the spigot end. Any coating removed from the cut end shall be repaired according to manufacturer's recommendation and/or Section 2.06 whichever method is more stringent in the opinion of the Engineer. Lining shall be undamaged. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints. Where field cuts are permitted, the pipe to be cut shall be supplied by the factory as "gauged full length". Should full length gauged pipe be unavailable, the pipe to be cut shall be field gauged at the location of the new spigot using a measuring tape, or other means approved by the manufacturer, to verify that the diameter is within the tolerances permitted in Table 1 of AWWA C151.

#### B. Jointing Ductile-Iron Pipe

1. Push-on joints shall be made in strict accordance with manufacturer's instructions, AWWA C600 and Appendix B of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is properly seated.
2. Mechanical joints shall be assembled in strict accordance with the manufacturer's instructions, AWWA C600 and Appendix A of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Pipe shall be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts shall be tightened to the specified torques. Under no condition shall

extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage. After installation, apply a bitumastic coating to bolts and nuts and install polyethylene encasement as specified.

3. Bolts in mechanical or restrained joints shall be tightened alternately and evenly. Restraint for mechanical joint pipe shall use retainer glands for restraining joint. All restrained mechanical joints shall be suitable for the specified test pressure.
  4. Restrained joints shall be installed according to pipe manufacturer's instructions.
  5. Flanged joints shall be assembled in strict accordance with the manufacturer's instructions and Appendix C of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Extreme care shall be taken to ensure that there is no restraint on opposite ends of pipe or fitting, which would prevent uniform gasket compression, cause unnecessary stress, bending or torsional strains, or distortion of flanges or flanged fittings. Adjoining push on joints shall not be assembled until flanged joints have been tightened. Flange bolts shall be tightened uniformly to compress the gasket uniformly and obtain a seal. Flange bolts shall be left with approximately 1/2-inch projection beyond the face of the nut after tightening. After installation apply a bitumastic coating to the bolts and nuts as specified.
  6. Sleeve couplings shall only be installed for closure or as shown on the Drawings. Couplings shall not be assembled until adjoining joints have been assembled. After installation. Apply a heavy bitumastic coating to the bolts and nuts and install protective wrap recommended by the manufacturer or as required herein. Care shall be exercised to insure that the insulating properties of insulating and dielectric couplings are maintained.
- C. All blowoffs, outlets, valves, fittings and other appurtenances required shall be set and jointed as indicated on the Drawings in accordance with manufacturer's instructions.
- D. Install polyethylene encasement around ductile iron pipe to limits shown on the Drawings and in accordance with pipe manufacturer's recommendations.
1. Polyethylene encasement shall be installed per ANSI/ AWWA C105/A21.5, Method 'A' in accordance with section 2.15 of DIPRA's Installation Guide For Ductile Iron Pipe.
  2. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.
  3. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.
  4. Extreme care shall be taken to ensure that all rips or tears in the polyethylene encasement are properly repaired with additional tape and film as described in ANSI/AWWA C105/A21.5
  5. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement

### 3.03 BEDDING AND BACKFILL

- A. All buried ductile iron pipe shall be bedded in compacted crushed stone extending from 4" below the pipe up to a depth of  $\frac{1}{8}$  of the pipe diameter. The bedding material shall be compacted to 90% standard proctor density (ASTM D 698).
- B. For open ground areas, select common fill shall be used to backfill the pipe from the bedding up to the top of the pipe. The material shall be installed in lifts not to exceed 6" and compacted to 90% standard proctor density.

- C. For paved areas, AHTD Class 7 Aggregate fill shall be used to backfill the pipe from the bedding up to the pavement subgrade. The material shall be installed in lifts not to exceed 6" and compacted to 90% standard proctor density.
- D. All trenches shall be backfilled as soon as possible after installation of the pipelines and appurtenances. It may be necessary to backfill only a portion of the trench to allow adequate curing of concrete. The CONTRACTOR shall limit all open trenches to a minimum of 300 linear feet along public streets/highways/roads and shall completely backfill all trenches daily. Temporary road plating of open trenches in paved areas is allowed if approved by the street/road/highway department.
- E. All backfilling shall meet the requirement of Section 31\_2300.

#### 3.04 CONNECTIONS TO STRUCTURES

- A. Wherever a pipe 3-in in diameter or larger passes from concrete to earth horizontally, two flexible joints spaced from 2 to 5-ft apart depending on pipe size shall be installed, within 5-ft of the exterior face of the wall, whether or not shown on the Drawings.
- B. Unless otherwise specified, all pipes passing through a wall will utilize a wall pipe designed to pass the thrust through the wall via restraint to the wall pipe (either restrained joint or Megalug restrained MJ follower gland).
- C. Piping underneath structures shall be concrete encased.

#### 3.05 FILLING AND TESTING

- A. After installation, the pipe shall be tested for compliance as specified herein. Furnish all necessary equipment and labor for the hydrostatic pressure test on the pipelines.
- B. Submit detailed test procedures and method for Engineer's review. In general, testing shall be conducted in accordance with AWWA C600. The method and procedures for performing the hydrostatic pressure test shall be approved by the Engineer. Submit the plan for testing to the Engineer at least 10 days before starting a test.
- C. Pressure pipelines shall be pressure and leakage tested in accordance with Section 31\_0501. The hydrostatic testing allowances shall not exceed those indicated in AWWA C600. Provide suitable restrained bulkheads as required to complete the hydrostatic testing specified.
- D. CONTRACTOR shall make any taps and furnish all necessary caps, plugs etc, as may be required in conjunction with performing the testing.
- E. Gravity pipelines shall be subjected to hydrostatic pressure test as specified in AWWA C600.
- F. All valves and valve boxes shall be properly located and installed and operable prior to testing. Bulkheads shall be provided with a sufficient number of outlets for filling and draining the line and for venting air.
- G. Hydrostatic pressure tests shall conform to Section 5.2 of AWWA C600. Furnish gauges, meters, pressure pumps and other equipment needed to fill the line slowly and perform the required hydrostatic pressure tests.
- H. The UTILITY will provide a source of supply from the existing treated water distribution system for CONTRACTOR's use in filling the lines. An air break shall be maintained at all times between the UTILITY's distribution system and the CONTRACTOR's equipment to prevent cross-connection. The line shall be slowly filled with water and the specified test pressure shall be maintained in the



pipe for the entire test period by means of a pump furnished by the CONTRACTOR. Provide accurate means for measuring the quantity of makeup water required to maintain this pressure.

- I. The UTILITY shall supply, at no cost to the CONTRACTOR, a maximum quantity of water equal to 110 percent of the volume of the pipelines for testing. Additional water required by the CONTRACTOR will be provided at standard billing rates for the volume required. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the CONTRACTOR. Provide accurate means for measuring the quantity of makeup water required to maintain this pressure.
- J. Duration of pressure test shall not be less than 2 hours. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves and accessories shall be removed and replaced.

### 3.06 CLEANING

- A. At the conclusion of the work, thoroughly clean all of the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.
- B. After the pipe has been cleaned and if the groundwater level is above the pipe or water in the pipe trench is above the pipe following a heavy rain, the Engineer will examine the pipe for leaks. If defective pipes, fittings or joints are discovered at this time, they shall be repaired or replaced by the CONTRACTOR.

END OF SECTION



SECTION 33 1200  
VALVES AND HYDRANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all valves as shown on the Drawings and as specified herein.
- B. The equipment shall include the following:
  - 1. Valve Actuators - General
  - 2. Gate Valves
  - 3. Butterfly Valves
  - 4. Check Valves
  - 5. Air Release Valves
  - 6. Ball Valves
  - 7. Fire Hydrants
  - 8. Post Hydrants

1.02 RELATED WORK

- A. Piping is included in the respective Sections of Division 40.
- B. Certain appurtenances for individual types of pipe or systems are specified with the specific type of pipe or system. However, additional items are specified in this Section.
- C. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.
- D. Valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein are included in the Electrical and Controls specifications. Valve operators shall, however, be mounted at the factory on the valves as specified herein, as part of the work of this Section.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 3000, materials required to establish compliance with this Section. Submittals shall include at least the following:
  - 1. Certified drawings showing all important details of construction and dimensions.
  - 2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. The total weight of each item.
  4. A complete bill of materials.
  5. Additional submittal data, where noted with individual pieces of equipment.
  6. Location of the valve and actuator manufacturing facility.
  7. Electrical characteristics and wiring diagrams including but not limited to voltage, load in kW, Hp or FLA and phase.
- B. Test Reports
1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.
- C. Certificates
1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.
- D. Manufacturer's Installation and Application Data
- E. Operating and Maintenance Data
1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01 8823. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.
- F. Manufacturer's Warranty

#### 1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  2. ASTM A536 - Standard Specification for Ductile Iron Castings.
  3. ASTM B30 - Standard Specification for Copper Alloys in Ingot Form.
- B. American Water Works Association (AWWA)
1. AWWA C504 - Rubber-Seated Butterfly Valves
  2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
  3. AWWA C540 - Power-Actuating Devices for Valves and Slide Gates
  4. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
- C. American National Standards Institute (ANSI)

1. ANSI B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
  2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
  3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves
  4. ANSI B16.104 - Butterfly Valves
- D. American Iron and Steel Institute (AISI)
- E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)
1. MSS-SP-61 - Pressure Testing of Steel Valves.
  2. MSS-SP-67 - Butterfly Valves.
  3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
  4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.
  5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.
  6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
  7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.
  8. MSS-SP-82 - Valve Pressure Testing Methods
  9. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.
- F. National Electrical Manufacturers Association (NEMA)
- G. Underwriters Laboratories (UL)
- H. Factory Mutual (FM)
- I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.05 QUALITY ASSURANCE

##### A. Qualifications

1. Valves and appurtenances shall be products of well-established firms who are fully experienced, minimum 10 years, reputable and qualified in the manufacture of the particular equipment to be furnished. Bonds in lieu of experience will not be acceptable.
2. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with this Section as applicable.
3. All units of the same type shall be the product of one manufacturer.

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

- C. Inspection of the units may be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site at once.

1.06 SYSTEM DESCRIPTION

- A. All of the equipment and materials specified herein is intended to be standard for use in controlling the flow of water and air as noted on the Drawings.
- B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete workable systems.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Reference is made to Section 01 6610 for additional information.

B. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Engineer.
2. Prior to shipping, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
  - a. All valves 3-in and larger shall be shipped and stored on site until time of use with wood, plywood, or plastic covers on each valve end.
  - b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
  - c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
  - d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced at no cost to the Owner.

C. Storage and Protection

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

## 1.08 MAINTENANCE

- A. Special tools including packing maintenance hardware and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Sections 01 8823 and where noted, as specified herein.
- B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- C. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than 1 year after start-up and final acceptance.

## 1.09 WARRANTY

- A. The Contractor shall obtain from each valve and actuator manufacturer its warranty that the equipment shall be warranted for a period of 1 year from the date of Substantial Completion, as defined in the General Conditions, Division 0 and specified in Section 01 7836, to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), the part(s) shall be replaced in the equipment and the unit(s) restored to service at no expense to the Owner.

## PART 2 PRODUCTS

### 2.01 MATERIALS AND EQUIPMENT - GENERAL

- A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.
- B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- C. Valves and appurtenances shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.
- D. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or indelibly marked upon some appropriate part of the body.
- E. Unless otherwise noted, items shall have a minimum working pressure of 250 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.
- F. Joints, size and material - unless otherwise noted or required by the Engineer:
  - 1. Except where noted, all buried joints referred to herein shall be mechanical joint.
  - 2. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to unless otherwise specified.
  - 3. All valves exposed to view, or in vaults.
    - a. 2-1/2-in and smaller - threaded or soldered ends as required.

- b. 3-in - threaded or flanged as shown.
  - c. 4-in and larger flanged ends.
- G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.
- H. Valves and actuators located outdoors but not within a building; within maximum 2-ft above liquid; in vaults; or where otherwise noted shall be designed for submerged service where water may completely submerge the valve and operator. All other units shall have NEMA 4X enclosures. Valves and actuators to be installed within valve vaults in yard and designed for submerged service shall have Type 316 stainless steel bolts and hardware.

## 2.02 VALVE ACTUATORS - GENERAL

- A. See the Paragraph 2.01H above for submergence requirements.
- B. The valve manufacturer shall supply, mount and test all actuators on valves at the factory. The valves and their individual actuators shall be shipped as a unit.
- C. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.
- D. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.
- E. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in-place, with fastening top by Clow or equal.
- F. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.
- G. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.
- H. Additional valve actuator requirements are included with the individual valve types and as noted in Paragraph 1.02 above.
- I. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised castings. Decals or painted indications shall not be allowed.
- J. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

## 2.03 GATE VALVES (& TAPPING VALVES)

- A. Gate valves for water service shall be Mueller Resilient Wedge A-2362 gate valves, or equal.
- B. Valve ends for buried service shall be MJxMJ, unless otherwise noted, except tapping valves shall be equipped with one end as flanged to match tapping sleeve (MJxFL). Buried valves shall be NRS valves. Valves for exposed service shall be FLxFL, unless otherwise noted, and shall be supplied with a geared handwheel actuator NRS.



C. Tapping Sleeves

1. Smith Blair 662
2. All tapping sleeves shall be hydrostatic pressure tested at their max. rated working pressure for a min. of 1-hour prior to tap being made.

2.04 CHECK VALVES

- A. Check valves for water service shall be Val-Matic Swing-Flex check valves, or equal flexible disc swing check valves.

2.05 BUTTERFLY VALVES

- A. All butterfly valves shall be Pratt 2FII bonded seat Butterfly Valves as manufactured by Pratt, Lineseal XP11 as manufactured by Mueller, or equal. Refer to drawings for connection types (FL, MJ, etc..).

2.06 COMBINATION AIR VALVES

- A. The combination air valves shall be the 1" Model D-040 reinforced nylon body valve as manufactured by A.R.I. Flow Control Accessories, LTD.
- B. Valves shall be supplied with 1" NPT inlet.

2.07 BALL VALVES

- A. Ball valves shall be manually actuated unless otherwise shown on the Drawings. Valves shall be two piece, threaded, full port, 316 stainless steel construction. Valve seats shall be R-PTFE and easily accessible and replaceable. Valves shall be Dixon SSBV Series, or equal.

2.08 VALVE ACTUATORS

- A. The valve manufacturer shall supply, mount and test actuators on valves at the factory. The valves and their individual actuators shall be shipped as a unit.
- B. Unless otherwise noted on the Drawings, valves shall be manually actuated. Buried and exposed valves with operating nuts shall have a non-rising stem with an AWWA 2-in nut; At least two tee handles shall be provided for each different size operating nut. Unless otherwise noted, operation for valves shall be counterclockwise open. Where shown on the drawings exposed valves shall be supplied with geared actuators and handwheels.
- C. Actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.
- D. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

2.9 HYDRANTS

- A. Fire Hydrants
1. Fire hydrants shall be of standard manufacture and conform to the latest requirements of AWWA C502.

2. Hydrants shall be designed to be disassembled for maintenance without excavation.
3. The barrel and operating mechanism shall be designed so that the main valve will remain closed if the barrel is broken.
4. All hydrants shall be installed with an isolation gate valve on the hydrant lead. The hydrant lead shall be constructed of a ductile iron anchor tee or anchor coupling. No pipe pieces will be allowed.
5. Hydrants shall open to the left, be of the compression or gate type, and be provided with proper drip valve.
6. Each hydrant shall be served by a valve with an adjustable valve box.
7. A 4"x4"x4" anchor tee shall be required for fire hydrants on 4" waterlines.
8. The following specifications shall be included on all fire hydrants:
 

Size of barrel	6"
Valve opening	4-1/4"
Depth of bury	3-1/2 feet
Inlet Connection	Mechanical Joint
Outlets	(2) 2-1/2" hose outlets
Nozzle Arrangement	Oriented 45° angle, facing street.
Size of gate valve	6"
Nozzle Thread	National Standard
9. Hydrant shall be Model 129 as manufactured by M&H Valve Company, Anniston, AL, or equal.

B. Post Hydrants

1. Post hydrants shall be a nonfreezing, self-draining type.
2. Hydrants shall be furnished with a 2" FIP inlet, a nonturning operating rod, and shall open to the left.
3. Hydrants shall be designed to be disassembled for maintenance without excavation.
4. The outlet shall be a 2-1/2" bronze National Standard Thread.
5. Post hydrant shall be Style 33 Post Hydrant as manufactured by M&H Valve Company, Anniston, AL, or equal.

2.10 SURFACE PREPARATION AND SHOP COATINGS

- A. Notwithstanding any of the specified requirements, all coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.
- B. If the manufacturer's requirement is not to require finished coating on any interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to the Engineer.
- C. The exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer shall be applied in accordance with the instructions of the paint manufacturer. Primer shall be compatible with the finish coat provided.
- D. Unless otherwise noted, interior ferrous surfaces of all valves shall be given a shop finish of an AWWA C550 approved epoxy with a minimum thickness of 4 mil.
- E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.

- F. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

## 2.11 FACTORY INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.
- B. See Division 1 for additional requirements. Also refer to PART 1, especially for required submission of test data to the Engineer.
- C. In addition to all tests required by the referenced standards, the following shall also be factory tested:
  - 1. Pressure regulating valves shall be factory tested at the specified pressures and flows.

## PART 3 EXECUTION

### 3.01 INSTALLATION - GENERAL

- A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.
- B. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the work.
- C. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.
- D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.
- E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torquing requirements for all valves.

### 3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

- A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the Engineer to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves and appurtenances.
- B. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.

- C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform with the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

### 3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.
- B. No testing shall be performed until the manufacturer's service engineer has provided written certification that the following installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements:
  - 1. All motorized valves.
  - 2. All pressure regulating valves.
  - 3. Combination sewage air valve.
- C. Functional Test: Prior to startup, all items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. All motorized units shall be operated through 20 complete cycles, without vibration, jamming, leakage, or overheating and perform the specified function. All manual actuators shall be operated through ten complete cycles.
- D. The various pipelines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.
- E. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

### 3.04 CLEANING

- A. All items (including valve interiors) shall be cleaned prior to installation, testing and final acceptance.

END OF SECTION

## SECTION 331300

### POTABLE WATER SYSTEM DISINFECTION

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Disinfection of potable water distribution system.
- B. Test and report results.

##### 1.2 REFERENCES

- A. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
  - 1. AWWA C651- Standard for Disinfecting Water Mains (Latest Addition).
  - 2. AWWA C652- Standard for Disinfecting of Water Storage Facilities (Latest Addition).
  - 3. AWWA B300- Standard for Hypochlorite
  - 4. AWWA B301- Standard for Liquid Chlorine

##### 1.3 QUALITY ASSURANCE

- A. Testing Laboratory: Arkansas Department of Health or other approved laboratory.

##### 1.4 REGULATORY REQUIREMENTS

- A. Conform to AWWA C-651 or C-652 and Arkansas Department of Health regulations for Work of this Section.

##### 1.5 STORAGE AND HANDLING

- A. The Contractor is reminded that chlorine is a powerful oxidant and reacts readily with foreign substances.
- B. Chlorine compounds shall be handled and stored in accordance with manufacturer's recommendations.

#### PART 2 - PRODUCTS

##### 2.1 SODIUM HYPOCHLORITE

- A. Liquid form containing approximately 1 to 6 percent available chlorine.

#### PART 3 - EXECUTION

##### 3.1 PREPARATION

- A. Verify that piping system has been flushed and inspected.

### 3.2 DISINFECTION PROCEDURE

- A. All water lines shall be disinfected by the Contractor with chlorine before being accepted by the Owner and placed into service.
- B. During application of chlorine solution, use approved backflow prevention devices to prevent chlorine solution from flowing back into the distribution system.
- C. Water shall be flushed from blow-offs and hydrants to insure complete distribution of disinfecting agent throughout the system.
- D. Blow-offs and hydrants shall not be used for sample points.
- E. Contractor is responsible for all procedures necessary for proper disinfection of the water lines.
- F. Disinfect piping system in accordance with the most current version of AWWA C-651 and C-652.
  - 1. Continuous Feed Method:
    - a. Placement of calcium hypochlorite granules in the water storage facilities or in the water line during installation is not allowed.
    - b. Conduct preliminary flushing of water lines before filling activities of the water facilities in accordance with this section. Remove all debris from water storage facilities.
    - c. Only properly backflow prevented potable water may be used to disinfect waterlines or water storage facilities. Fill the water line or water storage facilities using 1% sodium hypochlorite solution to create water with an applied dosage of between 25 to 50 mg/L of free chlorine residual, unless the contractor can provide a free chlorine demand curve indicating that less may be used. Fill water storage facilities to overflow.
    - d. Retain or hold chlorinated water in water line or water storage facilities for 24-hours. Operate valves and hydrants during this time to disinfect these appurtenances.
    - e. Flush a sufficient amount of water from waterline to obtain a representative sample. Obtain a representative sample from water storage facilities. Free chlorine residual in water from waterline or water storage facilities shall not be less than 10 mg/l at the end of the 24-hour hold-period. If less than 10 mg/L of free chlorine residual is obtained, increase applied dosage, and repeat steps b through e prior to final flushing and bacteriological testing.
    - f. Conduct final flushing in accordance with this section.
    - g. Conduct bacteriological testing in accordance with AWWA C651 or C652 or this section.
  - 2. Tablet and Slug Methods are not be allowed under any circumstance unless approved, in writing, by the engineer.
- F. De-chlorination: Following disinfection the water used may contain high levels of chlorine. This is particularly true if the slug method of disinfection is used. If the level of chlorine is so high that damage would result if this water were released to the environment then de-chlorination will be required. Damage to the environment could mean fish kills, water discoloration, aquatic plant destruction or other similar event. De-chlorination by the addition of sodium sulfite or metabisulfite are methods that can be used to mitigate these

events. The contractor shall measure the level of chlorine in the water to be eventually disposed of and shall notify the Engineer and Owner of the result. If unacceptably high, in the opinion of the Engineer and authorities having jurisdiction, then a plan shall be prepared for de-chlorination. The Engineer and Owner will both review the plan with the Contractor before it is implemented.

G. Preliminary and Final Flushing

1. Flushing shall be no less than 2.5 ft./ sec.

PIPE DIAMETER (INCHES)	MINIMUM FLOW RATE (GPM)	MINIMUM FLUSH WATER AMOUNT NEEDED (GALLONS/ 1000 LF)
6	230	1515
8	390	2600
10	590	3910
12	840	5540
14	1120	7440
16	1450	9620
18	1820	12080
20	2230	14820
24	3180	21140
30	4890	32480

Minimum flushing duration shall be 6 minutes 45 seconds per 1000 LF of pipe **AFTER** minimum flow rate has been achieved.

2. Flush water from water line until chlorine measurements are no higher than the chlorine residual found in the existing distribution system.
3. Contractor shall take steps necessary during flushing to prevent erosion.

H. Bacteriological Tests:

1. Contractor shall obtain samples at a maximum spacing at no greater than 3,000 ft.
2. After final flushing, samples shall be obtained by the Contractor and submitted by the Contractor to the Arkansas Department of Health or approved laboratory. Two consecutive sets of water samples taken not less than 24 hours apart at each sample point must be declared acceptable by the Arkansas Department of Health before the waterline or water storage facilities will be accepted by the Owner. Be certain to coordinate the day of sampling with the laboratory in advance in order to avoid expiration of the samples due to time lag.
3. If samples collected are positive for coliform organisms, the disinfecting procedures and samples shall be repeated until two consecutive day samples are tested safe.

END OF SECTION





SECTION 431200  
VERTICAL MULTI-STAGE CENTRIFUGAL PACKAGED PUMP STATION

1.1 GENERAL

The pump station shall be supplied as a DUPLEX package system. The system shall include pumps, distribution control panel, control panel stand, controls, pipe valves & fittings, fabricated baseplates and all equipment and incidentals required to provide a complete pump station as specified herein. To ensure reliability and proper component integration package system must be provided by a UL listed manufacture conforming to NSF-61, UL508/A, UL778 & ULQCZJ.

1.2 OPERATING CONDITIONS

Each vertical inline pump shall be designed to handle water free of suspended solids rated 7.5HP, 230volts, 1-phase, 60 hertz, and 3600RPM. Unit shall be direct coupled and VFD controlled allowing for precise speed control to match field conditions. Package system shall produce 62 U.S. GPM at 200' feet TDH, with a minimum pump energy index (PEI) of 1.0. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The performance curve submitted for approval shall state in addition to head and capacity performance, NPSHr, the pump efficiency, impeller size.

Booster Pump Station	Pump 1	Pump 2
Model	10eSV	10eSV
Station Feed Power	230V/60Hz/1pH	230V/60Hz/1pH
Pump Motor Power	230V/60hz/3pH	230V/60hz/3pH
Total Station Design Flow (both pumps)	62GPM	62GPM
SINGLE Pump Design Flow (one pump)	62GPM	62GPM
Design Head	200'	200'
Maxiumn HP (Non-Overloading)	7.5HP	7.5HP
Max Stages	6	6
Suction Manifold (customer connection)	2"	2"
Discharge Manifold (customer connection)	2"	2"

1.3 SCOPE OF SUPPLY

The contractor shall furnish and install a complete factory built above ground constant pressure booster pump station. The station shall be complete with all necessary equipment installed on a fabricated steel base for placement on site built concrete padand enclosure. The package system shall be Model EVI as manufactured by CLAY-GREENE PACAKGE SYSTEMS a div of Morrow Water Technologies, or equal.

#### 1.4 PUMP DESIGN

The pump shall be a non-self-priming vertical multistage pump coupled to a standard NEMA ODP/OPSB continuous duty highly efficient motor. The liquid end located between the upper cover and the pump casing shall be held in place by tie rods. Pump shall be manufactured by Goulds Water Technology or equal. The pump volute, casing, impeller, diffuser bowl shall be AISI 304L or 316L stainless steel. The pump shall conform to NSF-61 for potable water applications.

- A. Casing- shall be laser welded AISI 304L or 316L stainless steel and capable of withstanding a minimum maximum working pressure of 360psi. Pump shall be of the inline type and shall be compatible with ANSI raised faced flanges. Pumps with suction and discharge not on the same center line will not be equal or acceptable.
- B. Wear ring- wear rings composed of PPS shall be provided in each stage. Wear rings shall be self-centering and of a replaceable design to ensure long service life.
- C. Impellers shall be of the enclosed design and constructed of AISI 316L or AISI 304L stainless steel. Impellers shall provide internal thrust balance in each stage.
- D. Diffuser Bowl- Each stage shall have a bowl with attached diffuser and be constructed of AISI 304L or 316L stainless steel.
- E. Seal Housing- Shall be of concave design and shall hold the seal faces below the topmost part of the pump casing.
- F. Seal- Shall be of a standard design and shall be removable from the pump for replacement without disturbing the pump body. The seal shall be equipped with a carbon rotating face vs a silicon carbide stationary face with elastomers of Viton or EPR. The seal shall be in accordance with ISO-3069 & EN-12756.
- G. Shaft Sleeve & Bearing- Pump shaft sleeves shall be made of tungsten carbide with ceramic bearings. Shaft stick up shall be set with a standard spacer from the factory.
- H. Suction & Discharge Spools- shall be one-piece cast iron, class 30 and shall be ANSI flanged with one (1) 1-1/4" air release port and one (1) 1/4" gauge port.

#### 1.5 MOTOR

The pump drive motor shall be NEMA standard design TC frame suitable for vertical mounting and close coupled to the pump unit. Motor shall be manufactured by Baldor/Reliance Weg, Worldwide Electric. The motor shall be of standard manufactures catalog design and must not use special bearings as a thrust handling device. Motors shall have ODP/OPSB enclosure and be continuous duty highly efficient. Motors shall be UR, CSA and CSA EEV listed. The stator windings shall have Class F insulation and be designed for inverter duty.

#### 1.6 TESTING

Commercial testing shall be required and include the following:

- A. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase and hertz.
- B. The motor seal and housing chambers shall be meggered for infinity to test for moisture content or insulation defects.
- C. Certified Test Curve- Non-Witnessed Hydraulic Institute Performance Test showing conditions of service as specified above. Curve shall be submitted to engineer for approval prior to shipment.

#### 1.7 PUMP CONTROL

Booster Pump Station shall be provided with variable frequency drives (VFDs) for constant pressure or tank fill operation of pumping equipment. VFDs shall be properly sized for incoming power feed and pump station requirements, with a minimum amp rating of 125% of the motor FLAs. VFDs, control panels, transformers and all associated electrical equipment must be provided by the package system manufacturer in order to ensure system integration and sole source responsibility. VFDs shall be ABB ACQ-580, Aquavar IPC, or equal.

- A. Pump Station Functional Electrical Equipment-

- i. One (1) VFD per pump. VFDs shall be NEMA1 wall mounted type to minimize the amount of air turnover required in the station. VFDs shall be capable of managing variable speed multi-pump systems in a constant pressure application without the need for external PLCs. VFDs shall be equipped with quick start programming and integrated pump control logic for ease of use in the field. VFDs shall operate as lead-lag with switching control built into the VFD. Additional PLCs or other devices shall not be necessary for pump station programming or control.
- ii. Pump station shall be field configurable to operate as either local control as constant pressure or remote control (by others) as tank fill. Pump Stations requiring special tools, electrical changes or reprogramming for dual operation shall not be allowed or considered equal.
- iii. One (1) Pressure Transducer per drive with 4-20mA output with 0-200psi range. Shall be NSF-61 approved as manufactured by HO Trecice or equal. Pressure transducer shall terminate to VFD.
- iv. One (1) Distribution Control Panel (DCP). Station will be equipped with a NEMA-4X fiberglass panel with fused disconnect for each drive with a complete set of extra fuses, properly sized main breaker(s), branch circuit breaker(s), low suction pressure relay, green pump run light, red fault alarm light, remote mounted common alarm beacon, On-Off switches (to run permissive), lightning arrestor, incoming power feed distribution block. Shall have remote mounted keypads from VFD with Had-Off-Automatic buttons. VFDs shall come from the pump station manufacturer prewired to the DCP. DCP shall be UL508 labeled.
- v. If required, the pump station shall be supplied with a UL-listed 3R enclosed Hammond Power Solutions NQ series or equal step-down transformer for control power.
- vi. Feed power is noted above in section 1.2.

B. Functional Requirements-

- i. On pressure drop to pre-set (adjustable) level, lead pump will start. With lead pump operating, if pressure continues to drop to pre-set (adjustable) low level second pump will start.
- ii. Pump VFDs will adjust the speed of pump to match demand of the system.
- iii. Pump(s) will run until pre-set pressure is met (adjustable) then they will shut off.
- iv. System will alternate between lead-lag on run time and shall be programmable.
- v. If one pump should fail the second pump shall override control.
- vi. VFDs shall be equipped with low suction switch cut off to prevent equipment damage.
- vii. The system shall be field configurable to operate on remote (SCADA) control if needed.

## 1.8 ELECTRICAL COMPONENTS

All electrical components and materials supplied shall function as a complete unit to automatically control the booster pump station. All devices and material shall be new and of standard product design. All components used in the panel shall be Underwriters' Laboratory approved for the application. Electrical work shall be in accordance with the latest edition of the National Electrical Code (NEC-70).

- A. Wire- shall be stranded copper and sized as required for load and application according to NEC. All wiring on the rear of the inner door shall be neatly bundled using tie wraps or other means. All internal wiring on the backplate shall be neatly routed in wire duct with removable covers. All wiring shall be continuous point to point (no splices) and be totally accessible.
  - i. All conductors shall be 98% conductive annealed copper unless otherwise noted, UL listed and labeled.
  - ii. Conductors No. 10 and smaller shall be solid.
  - iii. Conductors No. 8 or larger shall be stranded.
  - iv. Branch circuits shall not be less than No. 12 copper wire type THW, THHN or THWN insulation.
  - v. All control and signal wire shall be a minimum of No. 14 AWG, 90-degree C insulated and color-coded, colors shall be as follows:
    - a. Red for all AC control
    - b. Blue for all DC control
    - c. Yellow for external source control
    - d. White for AC neutral
    - e. Green for equipment ground wiring
  - vi. Main Ground- Conductors for main ground form neutral bus or equipment grounding bus shall be bare copper.
- B. Mounting- All other components shall be securely mounted to the backplate with stainless steel hardware through machine thread tapped holes in the backplate. The screws shall be of adequate size for the device being secured. Permanent marking to identify each component as shown on the drawing shall be provided on the back plate and schematic laminated on the inside of enclosure door.
- C. Variable Frequency Drives (VFD)- shall be UL, cUL & CE listed and provide adjustable carrier frequency with IGBT power switching and utilize PWM technology. VFDs shall be completely integrated units including VFD and programmable pump specific control. PLCs or external control devices shall not be acceptable or approved equal. VFD shall function in an ambient temperature range between -15-degrees C and 40-degrees C and may operate up to 50-degrees C with a 1% derate for every 1-degree C. VFD shall operate in relative humidity range of 5% to 95%, no condensing. VFD shall operate at altitudes up to 1000M above sea level. VFD shall tolerate voltage variances of +/- 10% on input power and shall provide three phase output power from 0V to (Rated)V and frequency's from 0Hz to 60Hz. At a minimum, each VFD shall be equipped with.
  - i. Remote mounted keypads
  - ii. One (1) 4-20mA analog outputs
  - iii. One (1) 4-20mA analog inputs
  - iv. Multipump interface via RS485 cable
  - v. Three (3) digital inputs
  - vi. Three (3) digital outputs
  - vii. Two (2) pressure settings with one transducer
  - viii. Overvoltage protection
  - ix. Undervoltage protection
  - x. Input Phase Loss
  - xi. Phase imbalance
  - xii. Motor overcurrent
  - xiii. Ground Fault & Short circuit
  - xiv. Removable 16 character per line backlit display
  - xv. All faults shall be displayed in plain English terms and shall not depend on interpretation of error codes.

- xvi. Serial Communication Option- Modbus RTU, Profibus DP, Profinet, Modbus TCP, Ethernet.
- D. Pressure Transducer- a pressure transducer shall be furnished and installed in the piping of the pump station and shall be prewired. The Transducer shall be two wire type with a 4-20mA signal calibrated for 0 -300psig. Shall be of the NEMA -4X design and equipped with a ½” NPT male process connection (fluid) and a ½” NPT male electrical connection. Accuracy shall be +/- 1.5%. The diaphragm shall be 17-4PH stainless steel and case shall be 304 stainless steels. The Transducer shall be NSF-61 compliant. Manufactured by Goulds, HO Trerice or equal.
- E. Enclosures- DCP enclosure shall be NEMA-3R fiberglass shall be manufactured by Allied Molded, Hoffman or equal. VFDs shall be NEMA-1 as provided by the drive manufacturer with remote mounted keypads located in DCP.
- F. ON-Off Switches each pump shall be equipped with switches. The switches shall be Square-D model ZB5 Series or equal.
- G. Pump Disconnects- provide one (1) properly sized fused disconnect per pump shall be ABB OT or equal. Provide one set of spare fuses per pump.
- H. Main Circuit Breaker- shall be properly sized for pump station load and shall be Square-D QOU or equal.
- I. Branch Circuit Breakers- Shall be properly sized for load and shall be Square-D QOU or equal. At a minimum the DCP shall be equipped with:
  - i. One (1) Duplex GFI outlet
  - ii. One (1) Enclosure heater circuit
  - iii. One (1) Enclosure blower/vent fan circuit
  - iv. One (1) Spare
- J. Lightning Arrestor- Pump stations shall be equipped with one (1) properly sized lightning arrestor on the feed power. Shall be Square D SDS or equal.
- K. Switches- Convenience switches shall be Square-D model ZB5 series or equal.
- L. Pump Run Lights- DCP shall be equipped with one (1) green run light per pump. Shall be Square D ZB5 series or equal.
- M. Pump Fault Lights- DCP shall be equipped with one (1) red pump fault light per pump. Shall be Square D ZB5 series or equal.
- N. Common Alarm Light- DCP shall be equipped with one (1) red common fault light. Shall be Square D ZB5 series or equal.
- O. Remote Mounted Common Alarm Beacon with Horn: DCP shall be supplied with Edwards Model 51R-N5-40W Red exterior mounted flashing audible horn/beacon for Contractor to mount on exterior of proposed pump station building.
- P. Main Power Distribution Block- DCP shall be equipped with a properly sized incoming power distribution block. Shall be Bussmann, Square D or equal.
- Q. Control Transformer- On applications needing step-down transformer it shall be supplied and mounted on the control panel hoop. The transformer shall be properly sized for load and shall be UL-listed UL-3R enclosure with 180-degree C insulation system with 115-degree C rise. Shall be of the encapsulated design. Manufactured by Hubbell-Acme Electric or equal.
- R. Grounding lugs- Booster pump system shall be provided with two grounding lugs. One shall be located in the DCP with a secondary lug located on the baseplate. Lugs shall be manufacturer standard.
- S. Conduit- All conduit shall be of the flexible liquid-tight type or PVC NEC approved as manufactured by Grainger, Hubbell or equal.
- T. All electrical wiring shall be per NEC-70

### 1.9 BASEPLATE, PIPE, VALVES & FITTINGS

Baseplate- shall be computer aided designed (CAD) in SolidWorks and manufactured of a minimum of 4” channel steel which shall meet or exceed A-36 requirements. The design of all members shall be in accordance with the AISC Steel construction Manual (13<sup>th</sup> edition). Pump, piping, valves, electrical components shall be securely attached to the baseplate. Four lifting lugs shall be securely mounted to the frame to allow for movement of the system as one unit. The complete package shall be certified under UL-QCZJ. Field assembled or component build units in the field shall not be allowed or accepted.

- A. Pipe & Spools- Shall be 304 Stainless steel and shall conform to NSF-61
- B. Fittings- 2-1/2" and smaller shall be NSF-61 compliant sanitary clamp stainless steel or bronze. For 3" and larger all mainline pipe fittings shall be cement lined ductile iron conforming to ASTM A536 and ANSI/AWWA C104/A21.4. Shall be rated for 250psi.
- C. Suction & Discharge Headers- for 2-1/2" and smaller shall be sanitary clamp stainless-steel NSF-61 compliant. For 3" and larger headers shall be 304 stainless steel or cement lined ductile iron and shall be NSF-61 compliant. Flanges shall be ANSI class 150/300 raised or flat face flanged. Rating & Size shall be determined by discharge pressure as indicated in 1.2 above.
- D. Isolation Valves- All valves shall be NSF-61 compliant. Isolation valves 2-1/2" and smaller shall be ball valves and shall be manufacturers choice. Isolation valves 3" and larger shall be capable of drop tight service to 250psig. 3" and larger valves shall be full rated for bi-directional dead-end service and at a minimum these shall be equipped as:
  - i. Valve body shall be cast iron ASTM A126 Class B wafer lug style drilled and tapped for class 150 flanges.
  - ii. Body shall have integrally cast top plate for direct flush mounting of a manual actuator.
  - iii. Seat shall be molded in isolating body, steam and journal from water flow. The seat shall be EPDM.
  - iv. The disc shall be 304 stainless steel with polished edges.
  - v. The valve stem shall be one piece 416 stainless steel.
  - vi. Upper and Lower stem bearing shall be bronze.
  - vii. Valve shall be Del-Val or equal.
- E. Pressure Gauges- NSF-61 compliant suction and discharge pressure gauges shall be provided. Gauges shall have a 4" minimum diameter face. Gauges shall have 1/4" NPT connections located at the bottom of the gauge. The suction gauge shall be in 10psi intervals with graduation marks every 1psi. Discharge gauges shall be in 20psi intervals with graduation marks every 2psi.
- F. Check Valves- for 2-1/2" and smaller shall be stainless, bronze or iron NSF-61 compliant check valves with spring assisted seat. Swing check valves are not acceptable. 2-1/2" and smaller valves shall be manufacturer standard. For 3" and larger mainline piping shall be supplied with either a wafer style or a globe style check valve that is NSF-61 compliant with ASTM A126 Class B cast iron bodies and ASTM B584/B148 bronze and shall be manufactured by Val-Matic or equal.
- G. Name Plates- Package Booster Pump system shall receive a stamped aluminum nameplate with serial number and contact information. Nameplate shall be located on the front of DCP and shall be in high visibility green over silver.

#### 1.10 ENGINEERING DRAWINGS & TESTING

At a minimum package pump station shall be complete with the following documentation

- A. General Arrangement Drawings- manufacture shall be responsible for one (1) pre-submittal drawing, one (1) submittal drawing and one (1) revision of drawing at no additional charge to the owner.
- B. Electrical- one lines, and Distribution Control Panel (DCP) control narrative shall be submitted. Manufacture shall be responsible for one (1) pre-submittal drawing, one (1) submittal drawing and one (1) revision of drawing at no additional charge to the owner. Drawings must be digital.
- C. Performance Testing- Each pump shall have a factory certified (non-witness) test curve.
- D. Package Testing- package system shall have (non-witness) certified hydrostatic test of completed system.
- E. Lifting Plan- One (1) Standard lifting plan (drawing).
- F. Quality Control- Manufacturer shall comply with their standard quality control documentation.
- G. The manufacturer shall provide a minimum of two (2) days (8-hour days) of start-up and training.
- H. Thirty (30) month warranty from date of shipment.

END OF SECTION